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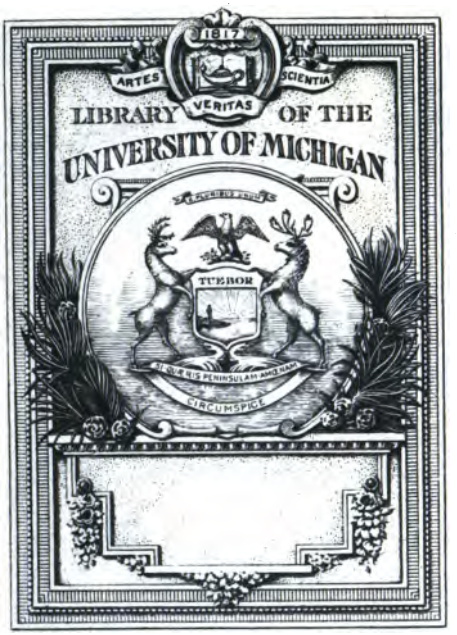
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God give him grace therein to look

Not only look but understand

For learning is better than house and land

When house and land is gone and spent

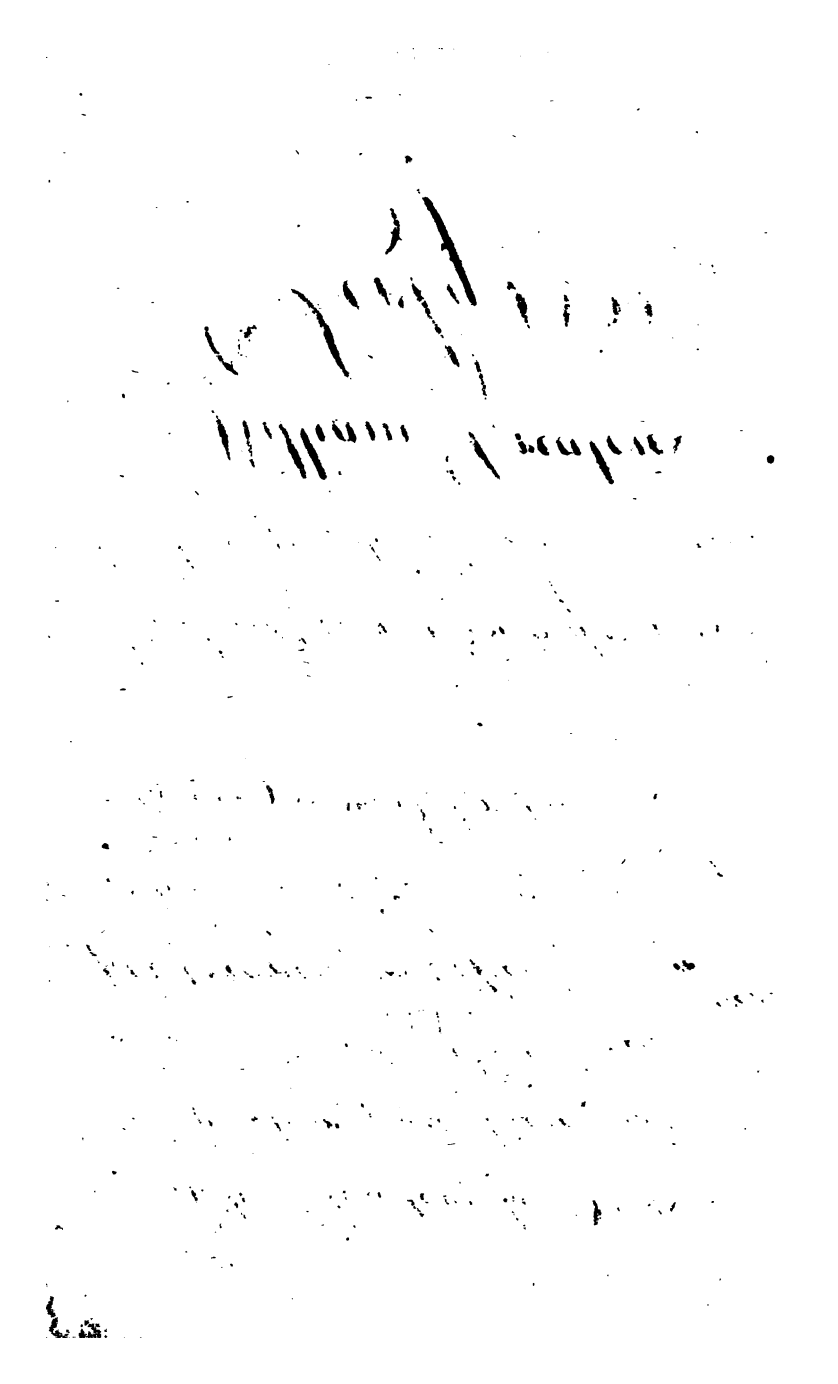
Learning is most Excellent

Steal not this Book for fear of shame

For here you see the owners name

William Greatorex

Derby 1831



THE

MOST GENERAL

# SCHOOL-ASSISTANT.

CONTAINING, A

## Complete Syſtem of ARITHMETIC:

The common and uſeful

## PROBLEMS in PRACTICAL GEOMETRY:

The Methods uſed in taking the

## DIMENSIONS of ARTIFICERS WORK:

## MENSURATION

Of all KINDS of SUPERFICIES and SOLIDS, of ARTIFICERS WORK, of TIMBER, and of LAND:

Together with

## GUAGING, BILLS of PARCELS, &c. &c.

By G. Gilbert DYER,

MASTER of the TUCKERS-HALL-SCHOOL, in EXETER.

"Were all the Books reduced to their Quinteſſence, many a bulky Author would make his Appearance in a Penny Paper: There would be ſcarce any ſuch Thing in Nature as a Folio: The Works of an Age would be contained in a few Shelves: Not to mention Millions of Volumes that would be utterly annihilated."

ADDISON. *Spect.* No. 124.

*EXETER:*

Printed by R. TREWMAN, for ROBINSON and ROBERTS, No. 25, in *Pater-Noſter-Row, London*; and ſold by E. SCORE, and W. GRIGG, in *Exeter*; J. FURSMAN, in *Aſhburton*; J. WALLIS, in *Plymouth*; W. CRAVEN, in *Dartmouth*; F. MURCH, in *Barnſtaple*, and all other Bookſellers.

[M.DCC.LXX.]

TO THE

# MASTER, WARDENS, *and* ASSISTANTS,

OF THE

# CORPORATION

OF

# FULLERS, &c.

In *EXETER*,

# This TREATISE,

Is, With all due RESPECT,

DEDICATED,

by

*Their most obliged,*

*Humble Servant,*

G. DYER.

EXETER, July 22, 1770.

# PREFACE.

AS the Intent and Uſe of a WORK, with an Apology for its Publication, is commonly expected, I ſhall, (although I think that the Contents of Treatiſes, not their Prefaces, are the Subjects of Utility and Conſideration) rather than offend, acquieſce with Cuſtom.

It is my Opinion, however, that no Apology can excuſe what is preſented to the Public unworthy their Notice: And that when an Author ſays more in Behalf of his Treatiſe than it deſerves, he deſires to impoſe on his Reader's Underſtanding.

Hoping then to give no Offence, and not to be tedious with a long Account of this Treatiſe, I ſhall in general only obſerve, *that herein is given,*

1. All the Rules, Definitions, *&c.* of Arithmetic, in a more brief and clear Manner than any I have yet ſeen, with proper Examples; together with ſome uſeful Remarks and Improvements.

2. The moſt uſeful Problems in Practical Geometry.

3. The Methods of taking Dimenſions in Artificers Work:

This laſt I found not only uſeful, but abſolutely neceſſary: Thro' the Ignorance of our Teachers in theſe Particulars, not *one Boy* in *one Hundred*, who has learnt Menſuration, knows from them how to apply it in the above Branches.

4. Menſuration of Superficies and Solids, applied to Artificers Work, Guaging, Meaſuring of Timber, *&c.* containing all the uſeful Rules, *&c.* with a competent Number of Examples to exerciſe each.

Hitherto we have not one ſingle Treatiſe which can be properly uſed as an Aſſiſtant to teach Menſuration by; all of them being confined to one or two Examples (and thoſe wrought too) to elucidate a Rule: But it is evident, when a Boy is put in the Way of applying a Rule, that he learns by having the ſame Thing ſtill inculcated: Therefore one or two Examples are inſufficient. For this Reaſon I have given a greater Number, which, together with the Directions for taking Dimenſions in Artificers Work, excluſive of other Things which might be conſidered, are a ſufficient Apology for this Publication.

Many other Things might have been here pointed out; but I chooſe rather to refer the judicious

dicious Reader to the Work itſelf, and conclude with this Requeſt, namely, That he will excuſe the Errors of the Preſs, and my Defects; will peruſe the Whole with Attention, and determine with Impartiality.

# CONTENTS.


| | | Page |
|---|---|---|
| NUMERATION, | | 1 |
| Addition, | of whole Numbers, | 3 |
| Subtraction, | of whole Numbers, | 3 |
| Multiplication, | of whole Numbers, | 4 |
| Diviſion, | of whole Numbers, | 6 |
| Addition, | of mixt Numbers, | 8 |
| Subtraction, | of mixt Numbers, | 13 |
| Reduction, | | 23 |
| Multiplication, | of mixt Numbers, | 25 |
| Diviſion, | of mixt Numbers, | 27 |
| Prime and Compoſite Numbers, &c. | | 29 |
| Of Vulgar Fractions, | | 31 |
| Reduction, | of Vulgar Fractions, | 31 |
| Addition, | of Vulgar Fractions, | 35 |
| Subtraction, | of Vulgar Fractions, | 35 |
| Multiplication, | of Vulgar Fractions, | 36 |
| Diviſion, | of Vulgar Fractions, | 36 |
| Of Decimal Fractions, | | 37 |
| Addition, | of Vulgar Fractions, | 38 |
| Subtraction, | of Vulgar Fractions, | 38 |
| Multiplication, | of Vulgar Fractions, | 38 |
| Diviſion, | of Vulgar Fractions, | 39 |
| Reduction, | of Vulgar Fractions, | 41 |
| Of the Ratio's of Numbers, and of Proportion, | | 43 |
| Rule of Three, | | 44 |
| Rule of Five, | | 47 |
| Practice, | | 49 |
| Tare, Trett, and Cloſſ, | | 55 |
| Loſs and Gain, | | 65 |
| Barter, | | 67 |
| Single Fellowſhip, | | 70 |
| Double Fellowſhip, | | 71 |
| Exchange, | | 72 |
| Compound Intereſt, | | 80 |
| Equation | | |

| | Page |
|---|---|
| Equation of Payments, | 82 |
| Allegation, | 82 |
| Arithmetical Progreſſion, | 85 |
| Geometrical Progreſſion, | 86 |
| Single Poſition, | 88 |
| Double Poſition, | 89 |
| Involution, | 90 |
| Evolution, | 92 |
| Of Infinite Decimals, &c. | 97 |
| Addition, of Infinite Decimals, | 99 |
| Subtraction, of Infinite Decimals, | 100 |
| Multiplication, of Infinite Decimals, | 100 |
| Diviſion, of Infinite Decimals, | 102 |
| Duodecimals, | 103 |
| Geometrical Definitions, | 105 |
| Geometrical Problems, | 109 |
| Of the Area of Plane Figures, | 115 |
| Dimenſions, &c. in Artificers Work, | 116 |
| Menſuration of Plane Figures, | 124 |
| Menſuration, &c. of Solids, | 141 |
| ——— of Timber, | 171 |
| Recreations, | 174 |
| Bills of Parcels, &c. | 183 |
| Receipts, | 189 |
| Promiſſory Notes, | 190 |
| Bills of Exchange, | 190 |

## *Of the* SIGNS *or* CHARACTERS *uſed in this* Treatiſe.

| | | | | |
|---|---|---|---|---|
| = | denotes | Equality, | and is named | equal to |
| + | | Addition, | | *plus* or more |
| − | | Subtraction, | | *minus* or leſs |
| × | | Multiplication | | into |
| ÷ | | Diviſion, | | by |

which ſtand for { 4+2=6, 4−2=2, 4×2=8, 4÷2=2 }

$\surd$ Is the Sign of Evolution, and being ſet before any No. denotes ſuch a Root is to be found as the Index directs, as $\surd^2 16$ or $\surd^2 16 = 4$ ſignifies that the ſquare Root of 16 is 4.

When a Line is drawn over any two Figures or Quantities, thus: $\overline{6+4} \times 4$, or $\overline{A - B} \times C$, it is called a *Vinculum*, and denotes that the Sum or Difference of the Numbers or Quantities under the Line (as there connected) muſt be multiplied by 4, or C.

The Figures connected with the following Signs, *to wit*. 2 : 4 :: 4 : 8, muſt be read thus; as 2 *is to* 4, *ſo is* 4 *to* 8.

## ERRATA.

Page 3, Line the laſt, for *Subtraction*, read *Subtractor*; P. 30, l. 3, for *the Sum*, r. *the greateſt common Meaſure*; P. 32, l. 10, for *or lower*, r. *and lower*; P. 39, l. 4, *B.* for *Cyphers*, r. *a Cypher*; P. 66, l. 3, *B.* for 5*l. per Ann.* r. 5 *per Cent. per Ann.* P. 62, l. 17, for *on*, r. *in*; P. 65, l. 36, for *or Deficiency of the firſt Coſt*, r. *or Difference of the Deficiency of the firſt Coſt, and firſt Coſt*; l. 2, *B.* for *or Deficiency of* 100, r. *or Difference of the Deficiency of* 100, *and* 100; P. 68, l. 5, *B.* for *Part*, r. *Payment*; Pa. 69, l. 26, for *n*, r. $\frac{a}{n}$; l. 30, for *be*, r. *be reduced*; P. 73, l. 9, at the End add *Sterling*; P. 86, l. 4, *B.* for *Extremes*, r. *Extreme*; P. 89, l. 16, dele 3; P. 98, l. 13, for $\cdot 3 = \frac{1}{3}$ *of* $\cdot 9$, read $3 = \frac{1}{3}$ *of* $\cdot 9$; l. 16, for $\cdot 23$, r. $\cdot 23$; P. 99, l. 5, for $\cdot 00849713$, r. $\cdot 00849713$; l. 19, for $\$571$, r. $\$571$; l. 27, for $\frac{2}{3} = \cdot 6$, r. $\frac{2}{3} = \cdot 6$; l. 31, f $\cdot 142857$, r. $\cdot 142857$; P. 102, l. 18, for $\cdot 428571$, r. $\cdot 428571$; l. 23, for $\cdot 0$, &c. r. $\cdot 02$, &c.; l. 24, for 93877551, r. 93877551; P. 119, l. 23, dele *one of*; P. 131, Fig. 1, for 9, r. $\cdot 9$; P. 136, l. 3, for 63, r. 21; P. 141, l. 25, for *which is*, read *with*; In Articles 306 and 310, for *firſt Axis*, read *fixt Axis*.

☞ *B ſignifies that you muſt reckon from the Bottom of the Page.*

☞ Through the kind Information of a worthy Correſpondent, I am enabled to inform the Reader, that for the Word *Quote*, uſed at ſome Places in this and other Treatiſes on Arithmetic, he ſhould read *Quotient*; the Uſe of the former in ſuch Places being not only improper, but tends to introduce an Ambiguity in the Language.

THE

# Moſt General School-Aſſiſtant.

## *Of* ARITHMETIC.

1. ARITHMETIC is the SCIENCE of NUMBERS, and the ART of COMPUTATION by them: As a Science it demonſtrates its Rules; and as an Art it puts them in Practice.

## *Of* NUMERATION.

2. NUMERATION or NOTATION ſhews how to expreſs or read any Number when written, and conſequently to write down any Number when propoſed.

By our Method of Numeration all Numbers are expreſſible by theſe Signs, named Digits, *viz.* by 1, 2, 3, 4, 5, 6, 7, 8, 9, and by the Help of the Sign 0, called a Cypher: Theſe Digits repreſenting Numbers from One to Nine included, (*i. e.* not joined to others, or a Cypher,) may be called, or ſaid to be of the firſt Denomination: With theſe to expreſs the Number Ten, the firſt of what may be called the ſecond Denomination, we put 10: But if the Sign 1, with a Cypher annexed, expreſs Ten, the Sign 2, with a Cypher annexed, will expreſs two Tens, or Twenty; the Sign 3, with a Cypher, three Tens, or Thirty, and ſo on to the Sign of Ten (10) with a Cypher, which will expreſs ten Tens, or one Hundred: And by the ſame Method of Reaſoning we find, that the aforeſaid Digits, with two Cyphers annexed, will expreſs Numbers which may be called of the third Denomination, as one Hundred, two Hundred, *&c.* to ten Hundred, or one Thouſand, the firſt of the fourth Denominations, *&c.* The intermediate Numbers are alſo expreſſed by applying the proper Digit or Digits in the Place of the Cypher or Cyphers.

From hence we obtain our Method of Enumeration, which the following Tables serve further to elucidate.

TABLE 1.

| Hundreds of Millions | Tens of Millions | Millions | Hundreds of Tho. | Tens of Thous. | Thousands | Hundreds | Tens | Units | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 1 | One |
| | | | | | | | 2 | 1 | Twenty-One |
| | | | | | | 3 | 2 | 1 | Three Hundred, Twenty-One |
| | | | | | 4 | 3 | 2 | 1 | 4 Thousand, 3 Hundred, 21 |
| | | | | 5 | 4 | 3 | 2 | 1 | 54 Thousand, 3 Hundred, 21 |
| | | | 6 | 5 | 4 | 3 | 2 | 1 | 6 Hundred 54 Thousand, 3 Hund. 21 |
| | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 7 Million, 654 Thousand, 321 |
| | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 87 Million, 654 Thousand, 321 |
| 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 987 Million, 654 Thousand, 321 |

TABLE 2.

| *Quadrillions.* | | *Trillions.* | | *Billions.* | | *Millions.* | | *Units.* | |
|---|---|---|---|---|---|---|---|---|---|
| *Tho.* | *Un.* | *Tho.* | *Un.* | *Tho.* | *Un.* | *Tho.* | *Un.* | *Tho.* | *Un.* |
| 234 | 324 | 272 | 424 | 724 | 224 | 427 | 242 | 242 | 724 |
| *h t u* | *h t u* | *h t u* | *h t u* | *h t u* | *h t u* | *h t u* | *h t u* | *h t u* | *h t u* |

From what hath been said, and the above Tables, it will be easy to express any Number when written, or to write down any Number when expressed, and therefore we shall give

EXAMPLES.

*Write down in Words the following Numbers*, viz.

42—472—470—4078—40784—820427—4072404—472673206—407248728 24, *&c.*

*Write down in Figures the following Numbers*, viz.

Forty-two—Fifty-four—Four Hundred and Eighty—Eight Thousand nine Hundred and Sixty-four—Four Million and Forty-two—Eleven Thousand Eleven Hundred and Eleven—One Hundred Million and Seventy-four—Three Hundred Forty-nine Billion, Two Thousand and Four, *&c.*

*Note*, It may not be improper here to observe, that a Simple Number is one which is abstractedly considered or applied to one Name, as 5, or 5*l*. And that a compound or mixt Number is one which is applied to several Names, every One whereof being of the same Kind, and containing, or being contained in, another, a known Number of Times, as 4 Yards, 3 Quarters, is a mixt Number of Measure, wherein the second Name Quarters is known to be contained in the first Name Yards four Times; and such Numbers are said to be Nos. of different Denominations.

Of

## *Of* ADDITION.

3. ADDITION is the collecting several Sums or Numbers into one Total or Sum.

### *A* General Rule *for* ADDITION.

Add up the first Right Hand Column or Denomination, and find how many Units of the next this Sum contains; put down the Remainder (if any) under the added Column, and carry the Units to the next, and so proceed through all the Columns.

Examples *in* Addition *of Simple or Whole Numbers.*

| *£.* | *lb.* | *C.* | *Tuns.* | *Yards.* |
|---|---|---|---|---|
| 2 | 427 | 34245 | 48784248 | 48784253 |
| 3 | 347 | 87425 | 3454257 | 87425678 |
| 3 | 874 | 78743 | 173454 | 345432 |
| 5 | 378 | 34578 | 4787345 | 434874587 |
| 9 | 457 | 25785 | 37875425 | 545643256 |
| 3 | 443 | 34732 | 73432125 | 24343458 |
| 5 | 254 | 34873 | 25487425 | 387248742 |
| 8 | 345 | 24784 | 23458784 | 25487345 |
| 2 | 247 | 34587 | 2545425 | 378742542 |

## *Of* SUBTRACTION.

4. SUBTRACTION is the taking one Sum or Number from another, to find thereby the Difference or Remainder.

### *A* General Rule *for* SUBTRACTION.

Begin with the first or Right Hand Column, and if the under Number is less than the Upper, put down the Difference; but if it is greater, increase the upper Figure by 10, when it is in the Place of Integers, but if it be in any Species of Money, Weight, Measure, &c. add to it such a Number as makes one of the next superior Denomination, then Subtract as before, and carry one to the next Figure in the Subtraction and so proceed.

EXAMPLES *in* SUBTRACTION *of Simple or Whole Numbers.*

| | | |
|---|---|---|
| From | 2874242487424874 | 487324374123 |
| Take | 1432121295213432 | 253212231011 |
| Remains | | |
| From | 207842541248723 87 | 34874325643456 |
| Take | 8742578432124874 | 3458732578758 |
| Remains | | |
| From | 876434578755456 45 | 27878742542873 |
| Take | 8734524784345 85 | 874254321345 |
| Remains | | |

## *Of* MULTIPLICATION.

5. MULTIPLICATION is a compendious Way of adding any Sum or Number, any Number of Times to itself; or of repeating a Sum or Number so many Times as the Multiplier contains Units.

The Sum or Number to be multiplied is called the *Multiplicand*, that whereby we multiply the *Multiplier*, and the Result of the Operation, the *Product*. The two first of these are also called *Factors*.

*A* RULE *to multiply Whole or Simple Numbers.*

Multiply each Figure in the Multiplicand by every Figure in the Multiplier, puting down what is under or over Ten or Tens, and for every 10 in such Product, carry 1 to the next, always remembering to set the first Figure of every Line under the multiplying Figure.

Hence it follows, that if Cyphers are joined to either or both Factors, they must be annexed to the Product of the Digits.

It also follows, that if Cyphers are placed between the multiplying Digits, they must be neglected, regard being had to the first Figure of every Line,

Note, *If the Multiplier is a composed Number*, you may Multiply by the Numbers it is composed of continually for the Answer.

MULTI-

## MULTIPLICATION TABLE.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
| 3 | | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 |
| 4 | | | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 |
| 5 | | | | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 6 | | | | | 36 | 42 | 48 | 54 | 60 | 66 | 72 |
| 7 | | | | | | 49 | 56 | 63 | 70 | 77 | 82 |
| 8 | | | | | | | 64 | 72 | 80 | 88 | 96 |
| 9 | | | | | | | | 81 | 90 | 99 | 108 |
| 10 | | | | | | | | | 100 | 110 | 120 |
| 11 | | | | | | | | | | 121 | 132 |
| 12 | | | | | | | | | | | 144 |

### EXAMPLES.

| | | | |
|---|---|---|---|
| 42789424 | 24297633 | 42977323 | 42724657 |
| 5 | 4 | 3 | 2 |
| 97237245 | 34947247 | 97245632 | 45350525 |
| 6 | 7 | 8 | 9 |
| | 0 | | |
| 95615076 | 27897505 | 92538669 | 29028565 |
| 11 | 12 | 12 | 11 |
| 349281 | 350464 | 351649 | 352836 |
| 591 | 592 | 593 | 594 |
| 206425071 | 207474688 | 208527857 | 209584584 |
| 91391 | 85432 | 57689 | 763847 |
| 4379 | 5763 | 57689 | 559874 |
| 400201189 | 492344616 | 3328020721 | 435296545278 |

| | | | |
|---|---|---|---|
| 1232010 | 12390400 | 3422250 | 352836 |
| 35100 | 3520 | 585 | 5940 |
| 43243551000 | 43614208000 | 2002016250 | 2095845840 |
| 127924 | 242723 | 27942 | 274563 |
| 34001 | 40702 | 27004 | 10702 |
| 4349543924 | 9879311546 | 735642968 | 2938362524 |

6. *To Multiply by* 13, 14, 15, 16, *&c. in one Line.*

Multiply each Figure in the Multiplicand, by 3, 4, 5, 6, &c. and to each single Product add its back Figure, and to the last Figure add what you carry.

Multiply 406835676 by every Number from 12 to 20.

7. *To prove Multiplication.* Expunge the Nines out of the Factors; the Excess of these multiplied together, and the Nines expunged, will be equal to what remains after the Nines are expunged out of the Product of the Factors, if the Work is right.

## *Of* DIVISION.

8. DIVISION teacheth to find how often one Sum or Number is contained in another: Or Division is a compendious Way of taking any Sum or Number from another, so often as the Least is contained in the Greatest.

The Sum or Number to be divided is called the *Dividend*, that whereby we divide the *Divisor*, and the Result the *Quotient*.

*A* RULE *to Divide whole Numbers.*

Take such a Part of the Dividend on the Left as is neither less than the Divisor, nor greater than its Product by 9; enquire how often the Divisor is contained in this Dividual; or rather seek how oft the first Figure of the Divisor in the first or two first Figures of this Dividual, and set the Figure that represents the Number of Times in the Quotient, remembering, however, that the Product of this Quotient Figure into the Divisor aforesaid, which is to be placed under the

the Dividual, muſt not exceed the ſaid Dividual; ſubtract this Product from the Dividual, and to the Remainder annex the next Figure of the Dividend for another Dividual, which, if leſs than the Diviſor, ſet a Cypher in the Quotient, and bring down another Figure; but if this or any other Dividual be equal to or exceed the Diviſor, proceed as before, until the Whole be divided.——— But

*If the Diviſor is a Number below* 13,

Find how often the Diviſor is contained in the firſt Dividual, and alſo what remains; ſet down the Quotient Figure under the laſt Figure of this Dividual, and ſuppoſe the Remainder ſtanding on the Left of the next Digit in the Dividend, and make that Sum the next Dividual, and find as before how often the Diviſor is contained in this Dividual, and ſo proceed with all the Figures of the given Dividend.

*Note* 1. Cyphers placed at the End of the Diviſor muſt be cut off, and the ſame Number of Places muſt be cut off in the Dividend.

2. If the Diviſor is a compoſed Number, divide by the Numbers it is compoſed of continually, and if you have a Remainder at any or every Step, Multiply each Remainder by the Diviſors to the preceding Steps continually, and to the Sum of theſe Products add the firſt Remainder for the complete Remainder.

3. When there is a Remainder in Diviſion, the Quotient is compleated by annexing the Remainder, placed over the Diviſor at the End.

EXAMPLES.

2)85449134(
3)128931969(
4)97190534(
5)213947129(

6(583423478(
7(244630729(
8(777965056(
9(381010708(

11(1069578026(
11(470070316(
12(111280400 9(
11(334766919(

41)68921 (1681
58)195112(3364
67)300753(4489
77)456533(5929

591)20642507(
592)20747468(
593)20852785(
594)20951458(

243)4278491(17606$\frac{2}{3}\frac{1}{3}$
7854)7429872(945$\frac{7}{8}\frac{8}{7}\frac{4}{4}\frac{2}{4}$
8972)7242876(807$\frac{2}{8}\frac{4}{7}\frac{7}{4}\frac{2}{4}$
2978)2473427(830$\frac{1}{2}\frac{6}{9}\frac{8}{7}\frac{7}{8}$

48|00)4272472|00(8900940
349|0)42732482|7(12244222470

87|00)48242474|00(554511$\frac{17}{87}$
982|0)42724372 4|7(435075$\frac{247}{9820}$

9. *To prove this Rule.* Reject the Nines in the Diviſor and Quotient, (ſeverally) and alſo in the Product of their Remainders; then, if the remaining Figure be equal to the re-

maining Figure of the Difference of the Dividend and its Remainder (after the Nines are expunged out of the said Difference) the Work is right.

## EXAMPLES *in* ADDITION *of* Mixt Numbers.

### 1. *Of* MONEY.

10. 4 Farthings make a Penny; 12 Pence a Shilling; and 20 Shillings a Pound Sterling.

PENCE TABLES.

| *d.* | | *s.* *d.* | *d.* | | *s.* |
|---|---|---|---|---|---|
| 20 | is | 1 8 | 24 | is | 2 |
| 30 | — | 2 6 | 36 | — | 3 |
| 40 | — | 3 4 | 48 | — | 4 |
| 50 | — | 4 2 | 60 | — | 5 |
| 60 | — | 5 0 | 72 | — | 6 |
| 70 | — | 5 10 | 84 | — | 7 |
| 80 | — | 6 8 | 96 | — | 8 |
| 90 | — | 7 6 | 108 | — | 9 |
| 100 | — | 8 4 | 120 | — | 10 |

| *£.* | *s.* | *d.* | *£.* | *s.* | *d.* | *£.* | *s.* | *d.* | *£.* | *s.* | *d.* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 472 | 13 | 9¼ | 9742 | 14 | 7½ | 97 | 14 | 8¾ | 2727 | 13 | 9½ |
| 74 | 21 | 8¼ | 907 | 0 | 4½ | 9 | 13 | 4½ | 967 | 16 | 7¼ |
| 2 | 13 | 5¼ | 974 | 13 | 0¼ | 74 | 14 | 11¼ | 9751 | 15 | 9¼ |
| 4 | 16 | 9¼ | 427 | 15 | 9¼ | 9 | 15 | 9½ | 97 | 12 | 10½ |
| 5 | 15 | 3½ | 970 | 14 | 11¼ | 7 | 17 | 8¼ | 9 | 17 | 11¼ |
| 9 | 17 | 0¼ | 7 | 13 | 4½ | 77 | 12 | 10¼ | 29 | 15 | 7¼ |

| *£.* | *s.* | *d.* | *£.* | *s.* | *d.* | *£.* | *s.* | *d.* | *£.* | *s.* | *d.* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 13 | 9¼ | 9 | 14 | 7¼ | 9 | 15 | 7½ | 97 | 13 | 8½ |
| 9 | 14 | 8¼ | 9 | 13 | 9½ | 7 | 14 | 9¼ | 7 | 15 | 8¼ |
| 3 | 0 | 5¼ | 9 | 15 | 0¾ | 9 | 15 | 10 | 9 | 16 | 9 |
| 2 | 15 | 9¼ | 7 | 15 | 9¼ | 9 | 14 | 5¼ | 9 | 12 | 8¼ |
| 5 | 15 | 7 | 9 | 16 | 4¼ | 7 | 15 | 9¼ | 9 | 15 | 6½ |
| 4 | 13 | 9½ | 9 | 17 | 9¼ | 9 | 2 | 7¼ | 92 | 12 | 2¼ |
| 6 | 16 | 7¼ | 9 | 15 | 11¼ | 5 | 13 | 9 | 2 | 2 | 8¼ |
| 27 | 16 | 9¼ | 9 | 16 | 9 | 9 | 17 | 10¼ | 7 | 12 | 6 |

Of

## 2. *Of* TROY-WEIGHT.

11. 24 Grains a Pennyweight; 20 Pennyweights an Ounce; and 12 Ounces a Pound Troy.

*Note*, By theſe Weights are weighed Gold, Silver, Jewells, &c.

| *lb.* | *oz.* | *dwt.* | *gr.* | *lb.* | *oz.* | *dwt.* | *gr.* | *lb.* | *oz.* | *dwt.* | *gr.* | *lb.* | *oz.* | *dwt* | *gr.* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 10 | 11 | 14 | 5 | 2 | 10 | 19 | 4 | 10 | 13 | 14 | 4 | 3 | 15 | 4 |
| 9 | 2 | 6 | 12 | 9 | 2 | 14 | 15 | 9 | 10 | 7 | 15 | 2 | 10 | 12 | 22 |
| 2 | 10 | 9 | 15 | 7 | 10 | 15 | 7 | 9 | 10 | 9 | 13 | 4 | 10 | 13 | 21 |
| 3 | 10 | 19 | 17 | 3 | 9 | 14 | 18 | 7 | 9 | 8 | 14 | 9 | 10 | 8 | 23 |
| 9 | 10 | 14 | 20 | 9 | 7 | 13 | 14 | 7 | 10 | 14 | 9 | 8 | 7 | 18 | 16 |
| 4 | 9 | 17 | 19 | 7 | 9 | 14 | 19 | 4 | 2 | 17 | 7 | 8 | 2 | 13 | 19 |

## 3. *Of* AVOIRDUPOISE-WEIGHT.

12. 16 Drams an Ounce; 16 Ounces a Pound; 28 Pounds a Quarter of one Hundred Weight; 4 Quarters, or 112 Pounds, one Hundred Weight; and 20 Hundred Weight a Tun. By theſe Weights are weighed Grocery Goods, *&c.*

*Note*, One Pound Avoirdupoiſe is equal to 14 *oz.* 11 *dwts.* 15½ *gr.* Troy; and one Pound Troy is equal to 13 *oz.* and 1-6th Avoirdupoiſe.

| *Tuns.* | *C.* | *Q.* | *lb.* | *oz.* | *drs.* | *Tuns.* | *C.* | *Q.* | *lb.* | *oz.* | *drs.* | *Tuns.* | *C.* | *Q.* | *lb.* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 427 | 15 | 3 | 15 | 12 | 15 | 5 | 18 | 1 | 11 | 15 | 12 | 9 | 14 | 0 | 18 |
| 9 | 17 | 3 | 12 | 13 | 11 | 2 | 12 | 2 | 18 | 15 | 10 | 9 | 19 | 2 | 17 |
| 3 | 15 | 1 | 11 | 15 | 10 | 8 | 11 | 1 | 15 | 13 | 15 | 8 | 11 | 1 | 11 |
| 9 | 13 | 2 | 19 | 15 | 13 | 7 | 18 | 3 | 19 | 12 | 13 | 5 | 12 | 3 | 18 |
| 7 | 17 | 1 | 00 | 11 | 11 | 8 | 19 | 1 | 18 | 11 | 11 | 7 | 17 | 2 | 11 |
| 9 | 12 | 2 | 18 | 10 | 13 | 2 | 17 | 2 | 19 | 15 | 15 | 9 | 11 | 8 | 15 |
| 9 | 19 | 1 | 10 | 15 | 15 | 9 | 16 | 3 | 18 | 14 | 11 | 5 | 19 | 1 | 14 |
| 9 | 18 | 3 | 19 | 11 | 10 | 7 | 15 | 1 | 17 | 11 | 15 | 9 | 10 | 9 | 19 |

## 4. *Of* APOTHECARIES-WEIGHT.

10. 20 Grains a Scruple; 3 Scruples a Dram; 8 Drams an Ounce, and 12 Ounces a Pound.

*Note*, The Pound and Ounce Apothecaries-Weight are the ſame with the Pound and Ounce Troy.

| lb. | ℥. | ʒ. | ℈. | gr. |
|---|---|---|---|---|
| 94 | 10 | 7 | 2 | 14 |
| 3 | 1 | 6 | 1 | 18 |
| 2 | 9 | 2 | 1 | 11 |
| 8 | 8 | 1 | 2 | 12 |
| 9 | 9 | 0 | 1 | 19 |
| 4 | 1 | 8 | 1 | 10 |

## 5. *Of* LONG-MEASURE.

24. 3 Barleycorns an Inch; 12 Inches a Foot; 3 Feet a Yard; 5 Yards and half a Rod, Pole, Perch, or Land-Yard; 40 Poles a Furlong; 8 Furlongs a Mile; 3 Miles a League; and 69 Miles and half a Degree.

| *Miles.* | *F.* | *P.* | *Yards.* | *F.* | *I.* | *B.* | *Y.* | *F.* | *I.* | *B.* | *M.* | *F.* | *P.* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 427 | 7 | 21 | 4 | 2 | 10 | 1 | 1 | 2 | 10 | 2 | 6 | 5 | 29 |
| 9 | 5 | 19 | 5 | 0 | 9 | 2 | 2 | 0 | 9 | 1 | 5 | 2 | 11 |
| 1 | 6 | 27 | 5 | 2 | 8 | 0 | 0 | 2 | 5 | 1 | 7 | 5 | 20 |
| 9 | 5 | 29 | 9 | 1 | 8 | 1 | 2 | 1 | 5 | 0 | 5 | 0 | 38 |
| 8 | 2 | 18 | 6 | 1 | 9 | 2 | 0 | 0 | 1 | 2 | 6 | 5 | 39 |
| 2 | 1 | 11 | 8 | 0 | 10 | 0 | 1 | 1 | 10 | 1 | 5 | 6 | 35 |

## 6. *Of* LAND-MEASURE.

25. 40 Square Poles a Rood, and 4 Roods an Acre.

| *Acres.* | *R.* | *P.* | *A.* | *R.* | *P.* | *A.* | *R.* | *P.* |
|---|---|---|---|---|---|---|---|---|
| 42 | 3 | 25 | 30 | 2 | 29 | 9 | 3 | 18 |
| 97 | 2 | 25 | 2 | 3 | 25 | 8 | 1 | 15 |
| 39 | 0 | 27 | 9 | 0 | 30 | 9 | 2 | 11 |
| 32 | 1 | 29 | 1 | 1 | 25 | 5 | 0 | 25 |
| 93 | 2 | 21 | 9 | 3 | 15 | 5 | 1 | 21 |
| 77 | 3 | 18 | 8 | 2 | 21 | 1 | 2 | 19 |

## 7. *Of* CLOTH-MEASURE.

26. 2 Inches and Quarter make a Nail; 4 Nails a Quarter; 4 Quarters a Yard; 5 Quarters an Ell English; and 3 Quarters an Ell Flemish.

| *Yards.* | *Q.* | *N.* | *Ell E.* | *Q.* | *N.* | *Ell F.* | *Q.* | *N.* | *Yards.* | *Q.* | *N.* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 427 | 3 | 3 | 427 | 1 | 3 | 424 | 2 | 0 | 457 | 3 | 2 |
| 974 | 0 | 0 | 444 | 1 | 2 | 500 | 3 | 2 | 555 | 0 | 3 |
| 742 | 2 | 3 | 560 | 3 | 0 | 563 | 0 | 3 | 303 | 3 | 0 |
| 974 | 2 | 2 | 344 | 2 | 3 | 222 | 3 | 0 | 932 | 3 | 2 |
| 745 | 3 | 2 | 290 | 0 | 2 | 328 | 2 | 3 | 983 | 0 | 3 |
| 749 | 3 | 0 | 999 | 3 | 2 | 230 | 0 | 2 | 440 | 2 | 2 |

## 8. *Of* ARTIFICERS WORK.

17. Artificers Work is meaſured by the Sq. Inch, ſquare Foot, ſquare Yard, ſquare of 100 Feet ſquare, and the ſquare Rod.—A ſquare Foot contains 144 ſquare Inches, a ſquare Yard 9 ſquare Feet, a ſquare Square 100 ſquare Feet, and a ſquare Rod 272¼ ſquare Feet.

*Note*, Glaſs, Plank, &c. is meaſured by the ſquare Foot; Painting, Wainſcotting, Plaiſtering, &c. by the ſquare Yard; Flooring, Rooffing, Tyling, Thatching, &c. by the Square of 100 Feet; and Brick Work by the Rod.

| *Square Feet.* | *S. In.* | *Sq. Yds.* | *F. ſq.* | *S. ſq.* | *S. F.* | *S. R.* | *S. F.* |
|---|---|---|---|---|---|---|---|
| 4739 | 143 | 9743 | 8 | 4278 | 49 | 4278 | 272 |
| 73 | 24 | 97 | 4 | 97 | 98 | 94 | 29 |
| 9 | 142 | 74 | 5 | 9 | 87 | 77 | 250 |
| 7 | 137 | 752 | 3 | 9 | 76 | 76 | 200 |
| 6 | 30 | 299 | 2 | 20 | 65 | 68 | 177 |

## 9. *Of* SOLID MEASURE.

18. 1728 ſolid Inches make a ſolid Foot, and 27 ſolid Feet a ſolid Yard.

*Note*, 1, Timber is generally ſold by the Load or Ton, a Load being 50, and a Ton 40 Cubit Feet.

2. In ſome Places 10 Cubit Feet is called a Hhd. and ſo 4 Hhds. make a Ton, and 5 Hhds. a Load.

| *Loads.* | *T.* | *Tons.* | *Feet.* | *Tons.* | *F.* | *H.* | *Loads.* | *H.* | *F.* |
|---|---|---|---|---|---|---|---|---|---|
| 427 | 45 | 974 | 34 | 475 | 3 | 9 | 4745 | 4 | 8 |
| 974 | 14 | 987 | 39 | 756 | 2 | 8 | 6494 | 3 | 9 |
| 247 | 30 | 769 | 20 | 745 | 3 | 7 | 7497 | 2 | 7 |
| 756 | 30 | 867 | 27 | 643 | 0 | 6 | 7425 | 0 | 5 |
| 759 | 48 | 798 | 35 | 479 | 1 | 5 | 6789 | 3 | 0 |

## 10. *Of* WINE-MEASURE.

19. 2 Pints a Quart; 4 Quarts a Gallon; 63 Gallons a Hogſhead; 2 Hogſheads a Pipe or But, and 2 Buts a Ton.

| *Tuns.* | *H.* | *G.* | *P.* |
|---|---|---|---|
| 942 | 2 | 44 | 5 |
| 97 | 0 | 60 | 6 |
| 74 | 3 | 25 | 4 |
| 57 | 2 | 55 | 0 |
| 775 | 3 | 30 | 8 |
| 94 | 0 | 49 | 5 |

| *Tuns.* | *B.* | *H.* | *G.* | *Q.* | *P.* |
|---|---|---|---|---|---|
| 4503 | 1 | 0 | 45 | 3 | 1 |
| 4569 | 0 | 1 | 54 | 0 | 0 |
| 9944 | 1 | 1 | 49 | 2 | 1 |
| 8209 | 0 | 0 | 60 | 1 | 0 |
| 4885 | 1 | 1 | 44 | 3 | 1 |
| 5655 | 0 | 0 | 56 | 2 | 1 |

| *Tuns.* | *H.* | *G.* | *P.* |
|---|---|---|---|
| 147 | 3 | 44 | 4 |
| 92 | 2 | 53 | 0 |
| 40 | 0 | 49 | 2 |
| 99 | 2 | 58 | 3 |
| 419 | 1 | 44 | 2 |
| 45 | 3 | 33 | 4 |

## 11. *Of* BEER-MEASURE.

20. 2 Pints a Quart; 4 Quarts a Gallon; 8 ½ Gallons a Firkin; 2 Firkins, or 17 Gallons, a Kilderkin; 2 Kilderkins, or 34 Gallons, a Barrel; and one Barrel and Half, or 51 Gallons, a Hogſhead, Country Meaſure.

*Note,* In *London* 8 Gallons make a Firkin of Ale, and 9 Gallons a Firkin of Beer.

| *Hhds.* | *G.* | *Q.* | *P.* |
|---|---|---|---|
| 4509 | 49 | 3 | 1 |
| 9088 | 40 | 0 | 0 |
| 5329 | 43 | 1 | 1 |
| 2876 | 28 | 2 | 0 |
| 5640 | 24 | 3 | 0 |
| 9824 | 45 | 2 | 1 |

| *Barrels.* | *G.* | *P.* |
|---|---|---|
| 5424 | 24 | 6 |
| 5539 | 16 | 4 |
| 8998 | 24 | 0 |
| 6609 | 25 | 5 |
| 4509 | 29 | 2 |
| 4598 | 28 | 3 |

| *Hhds.* | *G.* | *Q.* | *P.* |
|---|---|---|---|
| 29904 | 39 | 3 | 1 |
| 40599 | 48 | 2 | 0 |
| 40599 | 24 | 0 | 1 |
| 34820 | 45 | 1 | 0 |
| 98299 | 49 | 2 | 1 |
| 45466 | 30 | 3 | 0 |

## 12. *Of* DRY-MEASURE.

21. 4 Peck a Buſhel; 8 Buſhels a Quarter; 5 Quarters a Wey or Cart-Load; and 2 Weys a Laſt.

*Note,* A Peck contains 7 Quarts, 1 Pint and Quarter (nearly) of Beer Meaſure.

| *Laſts.* | *W.* | *Q.* | *B.* | *P.* |
|---|---|---|---|---|
| 5042 | 0 | 4 | 7 | 3 |
| 8844 | 1 | 3 | 5 | 0 |
| 4409 | 0 | 2 | 6 | 2 |
| 2293 | 1 | 0 | 5 | 0 |
| 9809 | 0 | 2 | 4 | 3 |
| 4939 | 1 | 3 | 3 | 0 |

| *Laſts.* | *Q.* | *B.* | *P.* |
|---|---|---|---|
| 9405 | 8 | 7 | 3 |
| 5929 | 3 | 5 | 0 |
| 5096 | 4 | 4 | 2 |
| 1882 | 6 | 3 | 1 |
| 0985 | 5 | 2 | 3 |
| 2340 | 5 | 5 | 2 |

| *Laſts.* | *W.* | *Q.* | *B.* | *P.* |
|---|---|---|---|---|
| 9446 | 1 | 3 | 7 | 3 |
| 9845 | 0 | 0 | 4 | 0 |
| 5509 | 1 | 2 | 5 | 2 |
| 4954 | 0 | 0 | 6 | 2 |
| 5099 | 1 | 3 | 3 | 0 |
| 2304 | 1 | 2 | 5 | 3 |

*Of*

## 13. *Of* TIME.

22. 60 Seconds make a Minute; 60 Minutes an Hour; 24 Hours a Day; and 365 Days a common Year.

*Note*, A True or Solar Year contains 365 Days, 5 Hours, 48 Minutes, and 57 Seconds.

| *Years.* | *Days.* | *H.* | *M.* | *S.* | *Years.* | *Days.* |
|---|---|---|---|---|---|---|
| 495 | 140 | 23 | 45 | 57 | 4439 | 182 |
| 304 | 239 | 19 | 24 | 44 | 7404 | 205 |
| 909 | 253 | 22 | 43 | 33 | 4306 | 249 |
| 298 | 244 | 19 | 32 | 55 | 2056 | 144 |
| 402 | 299 | 21 | 22 | 29 | 0398 | 255 |

## EXAMPLES *in* SUBTRACTION *of* Mixt Numbers.

### 1. *Of* MONEY.

| | £. | s. | d. | £. | s. | d. | £. | s. | d. |
|---|---|---|---|---|---|---|---|---|---|
| *From* | 427 | 13 | 7½ | 464 | 14 | 9½ | 427 | 13 | 9½ |
| *Take* | 97 | 13 | 9½ | 143 | 13 | 7½ | 217 | 12 | 8½ |
| *Remains* | | | | | | | | | |

| | £. | s. | d. | £. | s. | d. | £. | s. | d. |
|---|---|---|---|---|---|---|---|---|---|
| *From* | 427 | 19 | 8½ | 474 | 14 | 9½ | 427 | 11 | 9½ |
| *Take* | 97 | 13 | 10½ | 143 | 13 | 7½ | 214 | 12 | 8½ |
| *Remains* | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Borrowed,* | 974 | 13 | 7½ | 427 | 14 | 8½ | 974 | 13 | 9½ |
| *Paid at sundry Times.* | 9 | 13 | 7½ | 9 | 12 | 7½ | 97 | 14 | 8½ |
| | 2 | 12 | 9½ | 7 | 14 | 8½ | 9 | 13 | 8½ |
| | 9 | 19 | 11½ | 6 | 19 | 10½ | 7 | 13 | 10½ |
| | 4 | 12 | 7½ | 6 | 18 | 9½ | 9 | 04 | 4½ |
| | 9 | 18 | 6½ | 9 | 14 | 5½ | 8 | 13 | 5½ |
| *Paid in all* | | | | | | | | | |
| *Due* | | | | | | | | | |

*Of*

## 2. *Of* TROY-WEIGHT.

| | lb. | oz. | dwt. | gr. | lb. | oz. | dwt. | gr. | lb. | oz. | dwt. | gr. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *From* | 427 | 11 | 12 | 14 | 974 | 9 | 14 | 14 | 4274 | 9 | 11 | 13 |
| *Take* | 97 | 9 | 13 | 12 | 79 | 10 | 14 | 19 | 97 | 11 | 14 | 19 |
| *Rem.* | | | | | | | | | | | | |

## 3. *Of* AVOIRDUPOISE-WEIGHT.

| | Tons. | C. | Q. | lb. | oz. | drs. | Tons. | C. | Q. | lb. | oz. | drs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *From* | 2427 | 14 | 1 | 14 | 13 | 13 | 9742 | 14 | 2 | 14 | 12 | 10 |
| *Take* | 789 | 13 | 3 | 27 | 12 | 14 | 975 | 19 | 3 | 25 | 13 | 14 |
| *Rem.* | | | | | | | | | | | | |
| *From* | 9742 | 13 | 1 | 14 | 12 | 13 | 9742 | 14 | 2 | 14 | 12 | 10 |
| *Take* | 789 | 13 | 3 | 27 | 12 | 14 | 974 | 19 | 3 | 25 | 13 | 14 |
| *Rem.* | | | | | | | | | | | | |
| *Bought* | 427 | 14 | 1 | 14 | 13 | 14 | 7472 | 14 | 1 | 14 | 10 | 14 |
| *Sold again at sundry Times.* | 4 | 19 | 2 | 19 | 14 | 10 | 97 | 19 | 2 | 14 | 9 | 15 |
| | 5 | 13 | 4 | 12 | 13 | 13 | 97 | 14 | 3 | 15 | 4 | 10 |
| | 9 | 14 | 0 | 14 | 13 | 14 | 75 | 10 | 2 | 22 | 14 | 13 |
| | 5 | 15 | 3 | 15 | 15 | 15 | 45 | 15 | 0 | 23 | 15 | 13 |
| | 9 | 15 | 2 | 19 | 13 | 10 | 63 | 18 | 2 | 25 | 13 | 12 |
| *Sold in all* | | | | | | | | | | | | |
| *Remains* | | | | | | | | | | | | |

## 4. *Of* LONG-MEASURE.

| | Miles. | F. | P. | Yards. | F. | L. | Bo. | Miles. | F. | P. |
|---|---|---|---|---|---|---|---|---|---|---|
| *From* | 4272 | 5 | 18 | 974 | 2 | 9 | 1 | 987 | 3 | 14 |
| *Take* | 974 | 2 | 29 | 94 | 1 | 10 | 2 | 99 | 4 | 19 |
| *Rem.* | | | | | | | | | | |

*Of*

## 3. *Of* LAND-MEASURE.

| | A. | R. | P. | A. | R. | P. | A. | R. | P. | A. | R. | P. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Bought* | 42 | 2 | 27 | 42 | 1 | 19 | 52 | 1 | 14 | 94 | 2 | 19 |
| *Tilled* | 9 | 3 | 29 | 9 | 3 | 14 | 9 | 3 | 26 | 9 | 3 | 27 |
| *Untilled* | | | | | | | | | | | | |

## 6. *Of* CLOTH-MEASURE.

| | E. En. | Q. | N. | Yards. | Q. | N. | E. Fl. | Q. | N. | Yards. | Q. | N. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *From* | 4275 | 4 | 3 | 497 | 2 | 1 | 427 | 1 | 3 | 86 | 2 | 1 |
| *Take* | 96 | 4 | 3 | 9 | 2 | 3 | 9 | 1 | 3 | 5 | 2 | 3 |
| *Rem.* | | | | | | | | | | | | |

| | E. En. | Q. | N. | Yards. | Q. | N. | E. Fl. | Q. | N. |
|---|---|---|---|---|---|---|---|---|---|
| *Bought* | 34274 | 2 | 1 | 8976 | 3 | 2 | 9743 | 1 | 1 |
| *Sold at sundry Times.* | 93 | 3 | 2 | 8 | 2 | 3 | 93 | 2 | 3 |
| | 45 | 3 | 3 | 8 | 3 | 2 | 98 | 2 | 0 |
| | 96 | 0 | 0 | 7 | 0 | 3 | 85 | 0 | 2 |
| | 8 | 3 | 2 | 5 | 3 | 0 | 45 | 1 | 3 |
| | 9 | 2 | 3 | 8 | 2 | 3 | 56 | 2 | 0 |
| *Sold in all* | | | | | | | | | |
| *Unsold* | | | | | | | | | |

## *Of* SQUARE-MEASURE.

| | Sq. F. | Sq. In. | S.Y. | S.F. | Square. | F. | Rods. | F. |
|---|---|---|---|---|---|---|---|---|
| *From* | 37 | 13 | 243 | 4 | 4276 | 13 | 7656 | 141 |
| *Take* | 19 | 15 | 87 | 7 | 876 | 14 | 888 | 200 |
| *Rem.* | | | | | | | | |

## 8. *Of* SOLID-MEASURE.

| | Loads. | F. | Tuns. | F. | Tuns. | H. | F. | Loads. | H. | F. |
|---|---|---|---|---|---|---|---|---|---|---|
| *From* | 427 | 24 | 397 | 20 | 914 | 2 | 3 | 427 | 2 | 2 |
| *Take* | 88 | 15 | 9 | 27 | 9 | 2 | 2 | 9 | 3 | 4 |
| *Rem.* | | | | | | | | | | |

9. *Of* WINE-MEASURE.

| | *Tuns.* | *H.* | *G.* | *P.* | *Tun.* | *B.* | *H.* | *G.* | *Q.* | *P.* | *H.* | *G.* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *From* | 427 | 2 | 14 | 3 | 4274 | 0 | 0 | 00 | 0 | 1 | 422 | 10 |
| *Take* | 92 | 3 | 19 | 5 | 79 | 1 | 1 | 24 | 2 | 1 | 20 | 19 |
| *Rem.* | | | | | | | | | | | | |

10. *Of* BEER-MEASURE.

| | *Hogſh.* | *G.* | *Q.* | *P.* | *Bar.* | *G.* | *P.* | *Hog.* | *G.* | *Q.* | *P.* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *From* | 9274 | 19 | 1 | 0 | 742 | 14 | 3 | 5974 | 13 | 2 | 1 |
| *Take* | 975 | 27 | 2 | 1 | 89 | 15 | 3 | 59 | 14 | 3 | 1 |
| *Rem.* | | | | | | | | | | | |

*Of* DRY-MEASURE.

| | *Laſts.* | *W.* | *Q.* | *B.* | *P.* | *Laſts.* | *W.* | *Q.* | *B.* | *P.* |
|---|---|---|---|---|---|---|---|---|---|---|
| *From* | 427 | 1 | 2 | 4 | 3 | 4274 | 1 | 2 | 3 | 1 |
| *Take* | 92 | 1 | 3 | 5 | 2 | 974 | 1 | 2 | 4 | 3 |
| *Remains* | | | | | | | | | | |

*Of* TIME.

| | *Years.* | *Days.* | *H.* | *M.* | *S.* | *Years.* | *Days* | *H.* | *M.* | *S.* |
|---|---|---|---|---|---|---|---|---|---|---|
| *From* | 974 | 147 | 14 | 14 | 13 | 427 | 247 | 13 | 14 | 13 |
| *Take* | 97 | 129 | 19 | 17 | 27 | 9 | 354 | 14 | 19 | 14 |
| *Remains* | | | | | | | | | | |

## QUESTIONS *in the foregoing* RULES.

1. A Gentleman lays out as follows; with *A*, five Hundred Pounds, with *B*, ſeven Hundred and four Pounds, with *C*, one Thouſand and three Pounds, with *D*, ſeventeen Thouſand & forty Pounds, and with *E*, ten Thouſand Pounds, what did he lay out in all?

2. A Merchant finds himſelf indebted to *A*, four Hundred Pounds ſeven Shillings and Four-pence; to *B*. fifteen Hundred four Pounds and ſeven Pence; to *C*, ſeven Thouſand and

and forty Pounds; and to *D*, four Hundred fifty-four Pounds fourteen Shillings and seven Pence Halfpenny; what is he indebted to all?

3. What Number added to 484 makes the Sum 874258?

4. The Sum of two Numbers is 472, the least is 43, what is the greatest?

5. Subtract 24, 14, 18, 95, and 178, from 478000, and let me know the Difference?

6. What Number of Pounds, Shillings, Pence, &c. added to four Hundred Pounds and Seven-Pence Halfpenny, will give the Sum four Hundred and fifty Pounds. *Answ.* 49 *l.* 19 *s.* $4\frac{1}{2}$*d.*

7. What Sum being taken from 1500 *l.* leaves 490 *l.* 14 *s.* $1\frac{1}{2}$*d.* *Answ.* 1009 *l.* 5 *s.* $10\frac{1}{2}$ *d.*

8. What Number of Pounds, Shillings, &c. added to four Score Guineas, four Shillings, and Five-Pence Halfpenny, will give the Sum five Hundred and forty Pounds? *Answ.* 455 *l.* 15 *s.* $6\frac{1}{2}$*d.*

9. What is the Sum of 34, 427, 325, 54272, and 100000?

10. What is the Sum of 942, 3007, 4074895, and 972454?

11. Required the Product of 4272428 and 45? *Answ.* 1922592 60.

12. What is the Product of 104272487 and 4275? *Answ.* 4352648881925.

13. What is the Quotient of 78542478 divided by 247? *Answ.* $317576\frac{206}{247}$.

14. What is the Quotient of 89272904200 divided by 2800? *Answ.* $3188318o\frac{8}{28}$.

15. From 105 Guineas take 109*l.* 14*s.* $4\frac{1}{2}$*d.* and give the Remainder? *Answ.* the Remainder is 10*s.* $7\frac{1}{2}$*d.*

16. Borrowed 450*l.* paid in Part 57 *l.* wanting 4*s.* $7\frac{1}{2}$ *d.* what remains due? *Answ.* 393*l.* 4*s.* $7\frac{1}{2}$*d.*

17. If you have 745*l.* 14*s.* $9\frac{3}{4}$*d.* and are to pay 4500*l.* 14*s.* wanting $4\frac{3}{4}$*d.* what is wanting to make up the Sum? *Answ.* 3754*l.* 18*s.* 10*d.*

18. I having made a Payment of 743*l.* 12*s.* $6\frac{1}{4}$*d.* have still by me 256*l.* 7*s.* $5\frac{3}{4}$*d.* what Sum had I at first? *Answ.* 1000*l.*

19. Having 1000 *l.* in Cash, I make a Payment of 743*l.* 12*s.* $6\frac{1}{4}$*d.* what have I still by me?

20. I have 450*l.* 4*s.* 10*d.* on an Estate, which the Owner sells me for 1700*l.* what must I pay him? *A.* 1249*l.* 15*s.* 2*d.*

21. How many Days from January 1 to September 4? *Answ.* 247.

22. Bought

22. Bought fourteen Hundred Weight and twenty Pounds of Sugar; ſold again four Hundred Weight, two Quarters, and twenty-two Pounds; what Quantity remains unſold? *Anſw.* 9*C.* 1*qr.* 26*lb.*

23. In forty Tun, fourteen Pounds Groſs, of Logwood, Tare eleven Hundred Weight, and eighteen Pounds, how much Neat? *Anſw.* 39*T.* 8*C.* 3*qrs.* 24*lb.*

24. Bought 72 Tun of Iron, ſold again 56 Tun, wanting 17*C.* 1*qr.* 14*lb.* what remains in Hand? *Anſw.* 16*T.* 17*C.* 1*qr.* 14*lb.*

25. In 72*T.* 14*C.* 2*qrs.* 14*lb.* Groſs, Tare 4*C.* 2*qrs.* 19*lb.* how much Neat? *Anſw.* 72*T.* 9*C.* 3*qrs.* 23*lb.*

26. Suppoſe I have by me in Caſh 235*l.* 15*s.* 8¼*d.* when I receive three Bills on me, one for 143*l.* 7*s.* another for 176*l.* 16*s.* and the other for 82*l.* 2*s.* what Money do I want to pay off theſe Bills? *Anſw.* 166*l.* 9*s.* 3¾*d.*

27. A Merchant is owed 547*l.* of which Debt he is paid at one Time 94*l.* 12*s.* 6*d.* at another Time 127*l.* 15*s.* 6*d.* at another Time 67*l.* 4*s.* 5*d.* and at another Time 134*l.* 17*s.* 8*d.* what is ſtill owing? *Anſw.* 122*l.* 9*s.* 11*d.*

28. Bought 94 Tun of Logwood, ſold at one Time 12*C.* 3*qrs.* 14*lb.* at another Time 25*T.* 13*C.* at another Time 45*T.* 14*C.* 1*qr.* 14*lb.* what remains unſold? *An.* 21*T.* 19*C.* 3*qrs.*

29. What Change muſt be given againſt the Sum of a 36*s.* Piece, a Moidore, a Guinea, an Half-Guinea, a Quarter-Guinea, a Crown, and an Half-Crown, if I am to receive 5*l.* 7*s.*? *Anſw.* 3*d.*

30. If I give 3*d.* in Change againſt the Sum of a 36*s.* Piece, a Moidore, a Guinea, an Half-Guinea, a Quarter-Guinea, a Crown, and an Half-Crown, what do I retain in my Hands?

31. Two *Leaſes*, the one in Poſſeſſion and the other in Reverſion, were granted on an Eſtate for the Term of 99 Years each, the one dated in 1720, the other in 1733; I demand the Years expired and the Years to come on each Leaſe, it being now in the Year 1768? *Anſw.* the Years expired are 48 and 35, and the Years to come 51 and 64.

32. What is the Difference between twice Fourteen and twice Four and Twenty; alſo between thrice Five-and-Fifty, and thrice Fifty-five?

33. There are three Sums of Money which increaſe by an equal Difference, the greateſt is equal to the leaſt (the leaſt being 4*l.* 14*s.* 8¼*d.*) added to double the Difference of the 1ſt and

and 2d, and the Difference of the 2d and 3d is 10½*d*. Quere, the Sums, and their total Sum?

34. If I am indebted 10*l*. more than I can pay, and a Friend knowing my Circumſtances, enables me to leſſen the Debt by a Gift of 10 Times ſo much; I demand my Worth more than before the Gift? *Anſw.* 100*l*. is my Worth more than before the Gift, but my real Worth is but 90*l*.—*Hence, from the above, the Reaſon of* Algebraiſts *ſaying that leſs into leſs produceth more.*

35. Two Leaſes were granted on an Eſtate, each for a Term of 99 Years, one of which, in Poſſeſſion, hath 47, and the other, in Reverſion, 68 Years to come of the Term; I demand the Time expired on each Leaſe, the Year each Term was granted, and the Year each Term will end, it being now in the Year 1768? *Anſw.* the Leaſe in Poſſeſſion hath 52 Years expired, was granted in the Year 1716, and will expire in the Year 1815; the Leaſe in Reverſion hath 31 Years expired, was granted in the Year 1737, and will expire in the Year 1836.

36. *Ned Needy* having paid Mr. *Gripe* a Viſit, borrowed (or rather boldly took from him for a long Term) 4 Purſes, qt. 47*l*. 13*s*. each, but his Creditor knowing the Value of Money, ſent after him and fetched back 140*l*. 13*s*. 8*d*. what did poor *Ned* carry away? *Anſw.* 49*l*. 18*s*. 4*d*.

37. A Steward collects from ſeveral Manors conventionary Rent as follows; from *Bere Manor* 47*l*. where he allows for Taxes 14*l*. 17*s*. 7½*d*. from *Lee Manor* 49*l*. where he allows 14*l*. 1*s*. 9*d*. from *Ware Manor* 97*l*. where he allows 32*l*. 0*s*. 8*d*. from *Ham Manor* 70*l*. where he allows 19*l*. 4*s*. 9½*d*. I demand the Sum he allows, and the Sum of the Rent with and without the Deductions aforeſaid? *Anſw.* the Sum he allows is 80*l*. 4*s*. 9½*d*., Rent with the Deduction 343*l*. 4*s*. 9½*d*. without 263*l*.

38. There are three Numbers, the greateſt whereof is 84, and their common Difference 8; give the Square of each No. the Square of their continual Product, the Squares of their Sum and Difference, and the Square of the Sum of thoſe Squares? *Anſw.* 7056, 5776, and 4624, are reſpectively the Square of thoſe Numbers; 188453228544 the Sq. of their continual Product; 51984 the Square of their Sum; 64, and 256, the Squares of their Difference; and 3551464 564165640976416 the Square of the Sum of theſe Squares.

## REDUCTION.

23. REDUCTION shews how to convert Sums or Numbers from one Name, to others of the same Value, and may be performed by this

### RULE:

Multiply the given Sum or Number, when it is to be brought to a lower Name, or Divide it, when to be brought to an higher Name, by so many of the least Name as make one of the Greatest.

*Note* 1. When there are Names between the proposed and required, it is common to reduce the proposed to every-next less or greater Name for the required One.— And when a Compound Number is to be reduced to its lowest Name, they add, or take in, every given Part thereof in reducing to or with the Name it belongs to.

2. Every Remainder is of the same Name with its own Dividend, and in reducing small Names to greater, it is usual to place the Remainders according to the Order of their Names after the last Quotient for the Answer.

### EXAMPLES.——1. *Of* MONEY.

1. How many Farthings in 454 Pounds?
2. How many Pounds, &c. in 435840 Farthings?
3. How many Farthings in 574*l.* 13*s.* 9$\frac{1}{4}$*d.*
4. How many Pounds, &c. in 551701 Farthings?
5. How many Fifths of 1 Penny are in 479*l.* 14*s.* 9$\frac{1}{5}$*d.*
6. How many Pounds, &c. in 575686 Fifths of 1 Penny?
7. How many Eighths of a Penny are in 427*l.* 14*s.* 8$\frac{1}{4}$*d.*
8. How many Pounds, &c. in 821250 Eights of a Penny?
9. How many Farthings in 2424 Guineas, 14*s.* 4$\frac{1}{2}$*d?*
10. How many Guineas, &c. in 2444082 Farthings?
11. How many Farthings in 2472 Moidores, 14*s.* 7$\frac{1}{2}$*d?*
12. How many Moidores, &c. in 3204414 Farthings?
13. How many Farthings in 2472 Pieces of 36*s.* each, 11*s.* 7$\frac{1}{2}$*d.*
14. How many Pieces of 36*s.* each in 4272174 Farthings?

### 2. *Of* TROY-WEIGHT.

1. In 54*lb.* how many Ounces, Pennyweights, & Grains?
2. How many Pounds in 311040 Grains?
3. How many Ounces, Pennyweights, and Grains in 4274 Pounds, 1 Ounce, 11 Pennyweights, 11 Grains?
4. How many Pounds, &c. in 24618995 Grains?
5. How many Ounces, &c. in 8*lb.* 11*ox.* 11*dwts.* 11*gr.*
6. In 51635 Grains how many Pounds, &c.

*Of*

### 3. *Of* AVOIRDUPOISE-WEIGHT.

1. How many Drams in 14 Hundred Weight?
2. In 1568 Drams how many Hundred Weight?
3. In 427*C.* 1*qr.* 14*lb.* 2*oz.* 2*dr.* how many Drams?
4. How many Hundred Wt. &c. in 12253730 Drams?
5. How many Drams in 204 Tuns?
6. In 116981760 Drams how many Tuns?
7. In 427*T.* 14*C.* 2*qr.* 14*lb.* 14*oz.* 13*dr.* how many Drams?
8. How many Tuns, &c. in 245278445 Drams?

### 4. *Of* LONG-MEASURE.

1. How many Inches in 172 Miles?
2. How many Miles in 10897920 Inches?
3. How many Barley-Corns in 427 Miles?
4. How many Miles in 81164160 Barley-Corns?
5. How many Barley-Corns in 427 *M.* 7*F.* 14*P.* 4*Y.* 2*F.* 11*In.* 1*Barl.*
6. How many Miles, &c. in 81339334 Barleycorns?

### 5. *Of* CLOTH-MEASURE.

1. How many Nails in 38 Yards?
2. How many Yards in 608 Nails?
3. How many Nails in 427 Yards, 2 Quarters, 2 Nails?
4. How many Yards, &c. in 6842 Nails?
5. How many Nails in 427 E. Engliſh, 2 Qrs. 3 Nails?
6. How many Ells Engliſh, &c. in 8551 Nails?
7. How many Nails in 427 E. Fl. 1 Quarter, 2 Nails?
8. In 5130 Nails how many Ells Flemiſh, &c.

### 6. *Of* LAND-MEASURE, *&c.*

1. In 40 Acres how many Poles?
2. In 6400 Poles how many Acres?
3. How many Poles in 274 Acres, 2 Roods, 29 Poles?
4. How many Acres, &c. in 43629 Poles?
5. In 427 ſquare Feet how many ſquare Inches?
6. In 61488 ſquare Inches how many ſquare Feet?
7. In 4 ſquare Rods how many ſquare Feet?
8. In 1089 ſquare Feet how many ſquare Rods?

### 7. *Of* LIQUID-MEASURE.

1. How many Pints in 10 Tuns of Wine?
2. In 20160 Pints of Wine how many Tuns?
3. How many Pints of Wine in 724*T.* 1*Hd.* 34*G.* 2*Q.* 1*P.*

4. How

4. How many Tuns, &c. in 1460365 Pints?
5. How many Pints in 10 *London* Barrels of Beer?
6. In 2880 Pints how many *London* Barrels of Beer?
7. How many Pints in 10*Hhds.* 8*Gal.* Country Meaſure?
8. In 4144 Pints how many Hogſheads, &c. of Country Meaſure?
9. How many Pints in 54 Barrels of Ale London?
10. In 13824 Pints how many London Barrels of Ale?

### 8. *Of* DRY-MEASURE.

1. How many Pecks in 240 Laſts?
2. In 76800 Pecks how many Laſts?
3. In 5 Laſts, 6 Quarters, 6 Buſhels, how many Buſhels?
4. How many Laſts, &c. in 454 Buſhels?
5. In 10 Laſts, 6 Quarters, 6 Buſhels, how many Gallons?
6. In 6832 Gallons how many Laſts, &c,
7. In 20 Laſts, 1 Wey, 2 Quarters, 4 Buſhels, 1 Peck, how many Pecks?
8. In 6642 Pecks how many Laſts, &c.

### 9. *Of* TIME.

1. How many Minutes in 40 Months?
2. In 403200 Minutes how many Months?
3. In one Year ſuppoſing it 365 Days, 5 Hours, 48 Minutes, and 57 Seconds, how many Seconds?
4. In 31556937 Seconds, how many Days, &c.
5. How many Hours, Minutes, and Seconds in 427 Years?
6. How many Years in 9357508 Hours, 9 Min. 39 Sec.?
7. How many Seconds in a lunar Month or 29 Days, 12 Hours, 45 Minutes?
8. In 2551500 Seconds, how many Days, &c.?

24. PARTICULAR RULES for Reducing from a greater to a leſs Denomination.

1. *To reduce Tons Avoirdupoiſe to Drams,* multiply by 20, 4, 28, 16, 16.

2. *To reduce Pounds Troy to Grains,* multiply by 12, 20, 24.

3. *To reduce Miles to Barley-Corns,* multiply by 8, 40, 11, 18, 3.

4. *To reduce Yards Cloth Meaſure to Nails,* multiply by 4, 4.

5. *To reduce Acres into Poles,* multiply by 4, 40.

6. *To reduce Tons Wine-Meaſure to Pints,* multiply by 2, 2, 63, 4, 2.

7. *To*

7. *To reduce Lasts into Pecks*, multiply by 2, 5, 8, 4.
8. *To reduce Months into Seconds*, multiply by 4, 7, 24, 60, 60.

## TABLES *of* WEIGHTS, MEASURES, *&c.*

### TROY-WEIGHT.

Grains.
24 = 1 Pennyweight.
480 = 20 = 1 Ounce.
5760 = 240 = 12 = 1 Pound.

### APOTHECARIES-WEIGHT.

Grains.
20 = 1 Scruple.
60 = 3 = 1 Dram.
480 = 24 = 8 = 1 Ounce.

### AVOIRDUPOISE-WEIGHT.

Drams.
16 = 1 Ounce.
256 = 16 = 1 Pound.
7168 = 448 = 28 = 1 Quarter.
28672 = 1792 = 112 = 4 = 1 Hundred.
573440 = 35840 = 2240 = 80 = 20 = 1 Tun.

### WINE-MEASURE.

Cub. In.
$28\frac{7}{8}$ = 1 Pint.
231 = 8 = 1 Gallon.
9702 = 336 = 42 = 1 Tierce.
14553 = 504 = 63 = $1\frac{1}{2}$ = 1 Hogshead.
19404 = 672 = 84 = 2 = $1\frac{1}{4}$ = 1 Puncheon.
29106 = 1008 = 26 = 3 = 2 = $1\frac{1}{2}$ = 1 Butt or Pipe.
58212 = 20161 = 252 = 6 = 4 = 3 = 2 = 1 Ton.

ALE

ALE-MEASURE *in London.*

| Cub. In. | | | | | | | |
|---|---|---|---|---|---|---|---|
| 35¼ | = 1 Pint. | | | | | | |
| 282 | = 8 | = 1 Gallon. | | | | | |
| 2256 | = 64 | = 8 | = 1 Firkin. | | | | |
| 4512 | = 128 | = 16 | = 2 | = 1 Kilderkin. | | | |
| 9024 | = 256 | = 32 | = 4 | = 2 | = 1 Barrel. | | |
| 13536 | = 384 | = 48 | = 6 | = 3 | = 1½ | = 1 Hogſhead. | |

BEER-MEASURE *in London.*

| Cub. In. | | | | | | | |
|---|---|---|---|---|---|---|---|
| 35¼ | = 1 Pint. | | | | | | |
| 282 | = 8 | = 1 Gallon. | | | | | |
| 2538 | = 72 | = 9 | = 1 Firkin. | | | | |
| 5076 | = 144 | = 18 | = 2 | = 1 Kilderkin. | | | |
| 10152 | = 288 | = 36 | = 4 | = 2 | = 1 Barrel. | | |
| 15228 | = 432 | = 54 | = 6 | = 3 | = 1½ | = 1 Hogſhead. | |
| 30456 | = 864 | = 108 | = 12 | = 6 | = 3 | = 2 | = 1 Butt. |

BEER *and* ALE *in the Country.*

| Cub. In. | | | | | | | |
|---|---|---|---|---|---|---|---|
| 35¼ | = 1 Pint. | | | | | | |
| 282 | = 8 | = 1 Gallon. | | | | | |
| 2397 | = 68 | = 8½ | = 1 Firkin. | | | | |
| 4794 | = 136 | = 17 | = 2 | = 1 Kilderkin. | | | |
| 9588 | = 272 | = 34 | = 4 | = 2 | = 1 Barrel. | | |
| 14382 | = 408 | = 51 | = 6 | = 3 | = 1½ | = 1 Hogſhead. | |

Cub. In.

DRY-MEASURE.

| Cub. In. | | | | | | | |
|---|---|---|---|---|---|---|---|
| 33.6 | = 1 Pint. | | | | | | |
| 268.8 | = 8 | = 1 Gallon. | | | | | |
| 537.6 | = 16 | = 2 | = 1 Peck. | | | | |
| 2150.4 | = 64 | = 8 | = 4 | = 1 Buſhel. | | | |
| 8601.6 | = 256 | = 32 | = 16 | = 4 | = 1 Coom. | | |
| 17203.2 | = 512 | = 64 | = 32 | = 8 | = 2 | = 1 Quarter. | |
| 172032 | = 5120 | = 640 | = 320 | = 80 | = 20 | = 10 | = 1 Laſt. |

LONG

## LONG-MEASURE.

Inches.
7.92 = 1 Link.
12 = 1.515 = 1 Foot.
36 = 4.54 = 3 = 1 Yard.
198 = 25 = 16.5 = 5.5 = 1 Pole.
792 = 100 = 66 = 22 = 4 = 1 Chain.
7920 = 1000 = 660 = 220 = 40 = 10 = 1 Furlong.
63360 = 8000 = 5280 = 1760 = 320 = 80 = 8 = 1 Mile.

## SQUARE-MEASURE.

| Links | | | | | | |
|---|---|---|---|---|---|---|
| 1 = | Feet | | | | | |
| 2,295 = | 1 = | Yards | | | | |
| 20,755 = | 9 = | 1 = | Perches | | | |
| 625 = | 272,25 = | 30,25 = | 1 = | Chains | | |
| 10000 = | 4356 = | 484 = | 16 = | 1 = | Acres | |
| 100000 = | 43560 = | 4840 = | 160 = | 10 = | 1 | M |
| 64000000 = | 27878400 = | 3097600 = | 102400 = | 6400 = | 940 = | 1 |

## CLOTH-MEASURE.

Inches.
2¼ = 1 Nail.
9 = 4 = 1 Quarter.
36 = 16 = 4 = 1 Yard.
45 = 20 = 5 = 1 Ell English.
27 = 12 = 3 = 1 Ell Flemish.
54 = 24 = 6 = 1 Ell French.

## TIME.

Seconds.
60 = 1 Minute.
3600 = 60 = 1 Hour.
86400 = 1440 = 24 = 1 Day.
31556937 = 525949 = 8766 = 365.5° 48′ 57″ = 1 Year.

*Note*, 48 Farthings are 1s. 960 Farthings, or 240 Pence 1 £. Sterling.

## MULTIPLICATION *of mixt Numbers.*

25. TO *multiply different Denominations*, Multiply the Price, Quantity, &c. given by the given Number, carrying from one Denomination to another, as in Addition.

EXAMPLES of MONEY.

1. Multiply 4*l.* 14*s.* 8¼*d.* and 8*l.* 17*s.* 4½*d.* by every Number between 1 and 13.

2. What cost 7 *oz.* at 2*l.* 13*s.* 4*d.* and 4*oz.* at 4*s.* 4½*d.* per Ounce?

3. What cost 11 Yards at 4*s.* 8¼*d.* and 9 Yards at 11*s.* 8*d.* per Yard?

26. *When the Multiplier is only a Fraction*, multiply the Price given by the upper Term, and divide by the lower for the Answer.—— *But if it be a mixt Number*, add the former Product to the Product of the whole Number into the Multiplicand.

EXAMPLES.

What cost ½, ¼, ¾, 1¼, 2½, 11⅝, and 4$\frac{5}{7}$ Yards respectively, at 4*s.* 8*d.* per Yard? *Answ.* 2*s.* 4*d.*, 1*s.* 2*d.*, 3*s.* 6*d.*, 5*s.* 10*d.*, 11*s.* 8*d.*, 2*l.* 14*s.* 1½*d.*, and 1*l.* 0*s.* 9¼*d.*

27. *When the Multiplier exceeds* 12, *and is a composed Number*, Multiply the given Price by any Numbers the given No. is composed of continually for the Answer.

EXAMPLES.

1. Multiply 42*l.* 18*s.* 4¼*d.* by 48, 56, 64, and 72, separately? *Answ.* 1460*l.* 2*s.*, 2403*l.* 9*s.*, 2746*l.* 16*s.*, and 3090*l.* 3*s.*

2. What cost 15*C.* at 1*l.* 7*s.* 9*d.* and 16*C.* at 4*l.* 13*s.* 9*d*?

3. What cost 20*C.* at 4*s.* 7*d.* and 14 at 14*s.* 7*d.* per *C*?

4. What cost 112*C.* at 2*s.* 4*d.* and 1728 at 4*s.* 3½*d.* per *C*?

28. *But when the Multiplier exceeds* 12, *and is no composed Number*, work with the component Parts of the nearest composed Number, and add to, or subtract from, the Product, the Produce of so many Units as are between the Number taken and given—Or, find what 1 of the given Price comes to at every Denomination the given Number extends to, by multiplying by as many Tens, save one, as the given Number hath Digits; then multiply these Products by the Units in the given Number, which are of the same Denomination, the Sum of these last Products is the Answer.

EXAMPLES.

1. What cost 19, 29, 209, 504, 407, and 4072 Yards, at 4*l.* 4*s.* 4*d.* per Yard?

2. What cost 39*C.* at 47*l.* 13*s.* 7*d.* and 98*C.* at 5*l.* 4*s.* 9*d.*

3. What cost 107*C.* at 5*l.* 13*s.* 7*d.* and 4725*C.* at 7*l.* 13*s.* 4*d.* per *C*?

What

What cost 139 *C.* at either 47*l.* 13*s.* 7*d.*, 4*l.* 13*s.* 4*d.*, 3*l.* 12*s.* 6*d.*, 4*l.* 6*s.* 8*d.*, 2*l.* 3*s.* 4*d.*, or 1*l.* 16*s.* 3*d.* per *C*? *Ans.* 6627*l.* 8*s.* 1*d.*, 648*l.* 13*s.* 4*d.*, 503*l.* 17*s.* 6*d.*, 602*l.* 6*s.* 8*d.*, 301*l.* 3*s.* 4*d.*, and 251*l.* 18*s.* 9*d.*

EXAMPLES of WEIGHTS, MEASURES, &c.

| *Ells F. Q. N.* | *Yards. Q. N.* | *Ells E. Q. N.* |
|---|---|---|
| 37 2 3 | 21 3 3 | 37 4 3 |
| 6 | 5 | 3 |

| *C. qr. lb.* | *lb. oz. dr.* | *Tuns. H. G.* |
|---|---|---|
| 12 0 13 | 17 0 9 | 15 0 41 |
| 20 | 25 | 28 |

## DIVISION *of mixt Numbers.*

29. TO *Divide different Denominations by any Number*, Divide the Integral Part by short or long Division, as your Divisor requires it, and what remains, reduce to the next inferior Denomination, adding thereto the given Number of said Denomination. Divide this Sum as before, and so proceed; the Quotes placed in due Order are the Answer.

EXAMPLES of MONEY.

1. Divide 90*l.* 14*s.* 10*d.* by 4, 5, 6, 7, 8, 11, 13, 17, 19, 109, and by 115.
2. If 7 *oz.* cost 18*l.* 13*s.* 4*d.* what cost an Ounce?
3. If 4 *oz.* cost 17*s.* 6*d.* what cost an Ounce?
4. If 9 Yards cost 5*l.* 5*s.* what cost a Yard?
5. If 11 Yards cost 2*l.* 11*s.* 6¾*d.* what cost a Yard?
6. If 19 *Cwt.* cost 80*l.* 2*s.* 4*d.* what cost one *Cwt*?
7. If 39 *Cwt.* cost 1859*l.* 9*s.* 9*d.* what cost one *Cwt*?
8. If 98 *Cwt.* cost 513*l.* 5*s.* 6*d.* what cost one *Cwt*?
9. If 107 *Cwt.* cost 607*l.* 13*s.* 5*d.* what cost one *Cwt*?
10. If 4573 *Cwt.* cost 23779*l.* 12*s.* what cost one *Cwt*?
11. If 4725 *Cwt.* cost 36335*l.* what cost one *Cwt*?

30. *When the Divisor is a composed Number*, Divide the given Price by any Numbers the Divisor is composed of continually for the Answer.

EXAMPLES.

1. If 15 Yards cost 20*l.* 16*s.* 3*d.* and 25 cost 18*l.* 4*s.* 7*d.* what per Yard?

2. If 16 *C.* cost 75*l.* and 20 *C.* cost 4*l.* 11*s.* 8*d.* what is each per Hundred?

3. If 112 *C.* cost 13*l.* 1*s.* 4*d.* and 1728 *C.* cost 370*l.* 16*s.* what is each per Hundred?

4. If 32, 40, 56, 84, and 54 Yards cost, each Quantity, 25*l.* 4*s.* what cost a Yard of each?

EXAMPLES of WEIGHTS, MEASURES, &c.

1. Divide 270 (which account as Hundreds Weight, Pounds Troy, Yards, Ells English, Ells Flemish, &c.) by the 9 Digits, and by every Product following, *viz.* 48, 56, 45, &c.

| *E. F. Q. N.* | *Ya. Q. N.* | *E. E. Q. N.* |
|---|---|---|
| 6)227 1 2 | 5)109 2 3 | 3)107 4 1 |

| *C. Q. lb.* | *lb. oz. dr.* | *Tuns. Hs G.* |
|---|---|---|
| 20)242 1 8 | 25)425 14 4 | 28)424 2 14 |

EXAMPLES *to Exercise the two foregoing* RULES.

1. Bought 4 Packs, each qt. 8 Parcels, each Parcel 10 Pieces, and each Piece 24 Yards, what comes the Whole to at 25*l* 4*s.* for 40 Yards, and what is it per Yard? *Answ.* he Whole comes to 3864*l.* and the Rate per Yard is 9*s.* $9d\frac{3}{4}$.

2. Bought 242 Quarters of Corn, which cost 254*l.* 10*s.* for 100 Quarters thereof I gave 40*s.* per Quarter, what gave I per Quarter for the Remainder? *Answ.* 7*s.* $8\frac{3}{71}d$.

3. A Draper bought 4 Bales of Cloth, each qt. 6 Pieces, and each Piece 27 Yards, at 16*s.* 4*d.* per Piece, what was the whole Price, and the Rate per Yard? *Answ.* 19*l.* 12*s.* the Whole, and the Rate per Yard $7d.1q.2\frac{1}{3}$.

4. Bought 520 Bushels of Malt, at 4*s.* 8*d.* per Bushel, to pay $\frac{1}{4}$ of the Purchase on Delivery, and the Remainder in 3 Months, what is the Price of the Malt, and what must be paid on the Delivery? *Answ.* 121*l.* 6*s.* 8*d.* the Price of the Malt, and 30*l.* 6*s.* 8*d.* to be paid on Delivery.

*Of*

## *Of* PRIME *and* COMPOSITE NUMBERS, *&c.*

31. A *Prime Number* is that which no other Number but itſelf and the No. 1 will divide without a Remainder, as 2, 3, 5, 7, &c.

*Note* 1. Every No. not diviſible by a Number which is not greater than its Square Root is a prime No.

2. All prime No's. are odd except the No. 2.

3. All No's. which are not Multiples of Primes are prime No's.

4. In a Series of odd No's. every 3d Fig. from 3 is a Multiple of 3; every 5th Fig. from 5 is a Multiple of 5; every 7th from 7, a Multiple of 7, and ſo on.

32. A compoſed No. is one which may be divided by ſeveral No's. without a Remainder, as 6, 8, 9, 12, &c.

33. *Every compoſed No. may be reduced to a certain No. of Primes, called its Prime Diviſors,* by dividing the given No. continually by 2, 3, 5, and all the prime No's. which will divide it without a Remainder, uſing each ſo often as poſſible, until you get a Quotient leſs than the Diviſor, then theſe Diviſors with the laſt Quotient are the Primes compoſing the ſaid No.

What are the component Primes of 5250, of 2310, and of 96780? *Anſw.* to the 1ſt, 2, 3, 5, 5, 5, 7; to the 2d, 2, 3, 5, 7, 11; to the 3d, 2, 2, 3, 5, 5, 5, 17, 19.

34. *To find all the Diviſors or aliquot Parts of any Number,* find its component Primes, and then it is evident that one Prime of every Sort, the Square of any Prime, when two alike, the Product of any two of the given Primes, the Cube of any Prime, if 3 of 1 Sort, the Product of any 3 of the given Primes, the 4th Power of any Prime, when 4 given of a Sort, the Product of any 4, &c. will be the Diviſors.

What are the juſt Diviſors of $88 = \overline{1\times2\times2\times2\times11}$? *Anſ* 1, 2, 2×2, 2×2×2, 11, 2×11, 2×2×11, 2×2×2×11, =1, 2, 4, 8, 11, 22, 44, 88.

What are the juſt Diviſors of 960, its prime Diviſors being 1, 2, 2, 2, 2, 2, 2, 3, 5? *Anſw.* 1, 2, 3, 4, 5, 6, 8, 10. 12, 15, 16, 20, 24, 30, 32, 40, 48, 60, 64, 80, 96, 120, 160, 192, 240, 320, 480, 960.

35. Numbers are ſaid to be compoſed to each other when ſome No. greater than 1 will divide them all without a Remainder; ſo 14, 21, and 28, are compoſed to each other.

36. One No. is ſaid to meaſure, and to be an aliquot Part of another, when that other contains it a certain Number of Times without a Remainder; ſo 4 is a Meaſure, and an aliquot Part of 12.

37. A No. that divides ſeveral No's. exactly is called their common Meaſure, *to find which*, Divide the greateſt No. by the leaſt, when there are but two given; *or*, the Sum of the greateſt No's. by the leaſt, when more than two are given; and then divide every laſt Diviſor by the laſt Remainder, till nothing remains; the laſt Diviſor is the greateſt common Meaſure.*

What is the greateſt common Meaſure of 112 and 128, of 84 and 168, and of 16, 36, 96, and 112?

*Note* 1. If the two Right Hand Digits of any Number are diviſible by 4, the Whole is ſo.

2. If the Sum of the Digits of any Number is diviſible by 3 or 9, the Whole is diviſible by 3 or 9.

3. If the Right Hand Figures of any Numbers are meaſurable by 8, the Whole is ſo.

4. If the Right Hand Figure be a Cypher, or 5, the Whole is diviſible by 5.

38. Any No. that is diviſible by one or ſeveral No's. is a Multiple of that one or com. Multiple of thoſe ſeveral No's. *To find which*, ſet the No's. in a Line, and divide them by any No. which will divide moſt of them without a Remainder, and placing the Quotes underneath, with the No's. not divided, proceed the ſame continually untill the Reſults be all Units, the Product of the Diviſors is the common Multiple required.—— Or,

Multiply all the prime Numbers, and the Roots of ſuch as are Square Cube, &c. No's. together continually for the Anſwer.

EXAMPLES.

What is the leaſt common Multiple of 8, 32, 40. and of the 9 Digits? *Anſw.* to the 1ſt, 160, to the 2d, 2520.

What

---

* If after having divided a No. $a$ by another $b$, and found a Remainder $c$, &c. we come to a Remainder $m$, which will exactly divide the preceding one, this $m$ is the greateſt common Diviſor of $a$ and $b$: For $m$ dividing the foregoing one $d$, divides all the Parts $m+d+d$ &c. of $c$, and conſequently $c$ itſelf: And becauſe $m$ divides $d$ and $c$, and all the Parts $d+c+c+c$ and of $b$, it alſo divides $b$: And ſince $m$ divides $c$ and $b$, and all the Parts $c+b+b+b+b$ &c. of $a$, $m$ alſo divides $a$, and is ∴ a common Diviſor.

Now every common Diviſor $f$ of $a$ and $b$ is a Diviſor of every Rem. $c$, $d$, $m$, &c.

For the No. $a$ is a Whole, of which $b$ into $q$ is one Part, and $c$ the other ∴ every Diviſor of $a$ and $b$, which is a Diviſor of the Parts $b\,q$ of $a$, will be a Diviſor of $c$ alſo, which is the other Part:

$b$=102)438=$a$(4=$q$

$c$=30)102(3=$r$

$d$=12)30(2=$s$

$m$=6)12(2=$t$

What is the least No. which being divided by 2, 3, 4, 5, 6, will leave 1, but being divided by 7 leaves nothing? *Answ.* 301.

*Note,* Several Fractions may be reduced to their least common Denominator, by finding the least common Multiple of the given Denominators for the Denominator required, and then working as is directed in the latter Part of Inst. 44; but if what is there be considered, it is sufficient without this or any other Rule.

## VULGAR FRACTIONS.

39. WHEN a Number is divided into any Number of equal Parts, one or more of such Parts is called a Fraction, and is thus expressed:

$$\frac{1 \text{ Numerator}}{6 \text{ Denominator.}}$$

The Number under the Dash here 6 shews how many Parts the Integer or whole Thing is divided into, and is from thence called the *Denominator*. The No. over the Dash expresseth the Parts taken, and is therefore called the *Numerator*. Hence, if the Numerator is equal to, or greater than, the Denominator, the Fraction is an *improper One*, as $\frac{4}{4}$ or $\frac{5}{4}$: But if the Numerator is less than the Denominator, such Fraction is *a proper One*, as $\frac{1}{4}$ or $\frac{3}{4}$.

*A compound Fraction* is a Fraction of a Fraction, as $\frac{1}{2}$ of $\frac{1}{4}$. *A mixt Number* consists of a whole Number and a Fraction, as $2\frac{1}{2}$.

*Note,* A whole Number is expressed Fraction-ways by putting 1 under it, thus, 4 is expressed $\frac{4}{1}$.

## REDUCTION of VULGAR FRACTIONS.

40. *To reduce Fractions to their lowest Terms,* Divide both given Terms by any Number that will divide them without a Remainder, Divide these Quotes again the same, and the next again, continuing so till the Quotients can be brought no lower, the last Quotients are the lowest Terms.

Or Fractions may be brought to their lowest Terms by dividing the given Terms by their greatest common Measure.



Part: If $f$ be a Divisor of $b$ and $c$, it will for the same Reason be a Divisor of the Remainder $m$: But this Divisor cannot be greater than $m$ which it divides; therefore $m$ is the greatest common Divisor, *Q. E. D.*

EXAMPLES.

Reduce $\frac{18}{24}$, $\frac{84}{108}$, $\frac{144}{216}$, and $\frac{576}{640}$, each to their lowest Terms.

Reduce $\frac{147}{252}$, $\frac{112}{128}$, $\frac{574}{861}$, and $\frac{6888}{10332}$, to their lowest Terms by a common Measure.

41. *To reduce compound Fractions to single Ones*, Multiply the Numerators together for a new Numerator, and the Denominators together for a new Denominator.

*Note*, In Reducing or Multiplying Fractions, if the same No. or No's. or the component Parts of the No. or No's. be the same in both the upper or lower Terms to be Reduced, or Multiplied, reject them.

EXAMPLE.

Reduce $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ to a single Fraction?

*Answ.* $\frac{2\times3\times4}{3\times5\times2\times4}=\frac{3}{10}$

Reduce $\frac{7}{8}$ of $\frac{4}{6}$ of $\frac{9}{10}$, $\frac{2}{9}$ of $\frac{5}{6}$ of $\frac{5}{9}$ of 6, and $\frac{2}{3}$ of $\frac{5}{7}$ of $\frac{7}{8}$ separately to single Fractions.

42. *To reduce mixt Numbers and Integers into improper Fractions, having assigned Denominators*, Multiply the Integer by the given Denominator, the Product (with the given Numerator added, when a mixt No.) is the Numerator to the given Denominator.

EXAMPLES.

Reduce 16 to an improper Fraction, whose Demominator shall be 6.

Reduce $14\frac{3}{4}$, $6\frac{3}{4}$, $16\frac{18}{100}$, and $19\frac{7}{9}$ to improper Fractions.

43. *To reduce improper Fractions to their Equivalent whole or mixt Numbers*, Divide the Numerator by the Denominator for the Integer, and under the Remainder, when any, subscribe the Denominator.

EXAMPLE.

Reduce $\frac{96}{6}$, $\frac{59}{4}$, $\frac{27}{4}$, $\frac{1618}{100}$, and $\frac{178}{9}$, to their equal whole or mixt Numbers.

44. *To bring Fractions of different Denominators into one common Denomination*, Multiply each Numerator into all the Denominators, except its own, continually for each new Numerator, and all the Denominators together continually for a new Denominator. — Or,

Divide the new Denominator by the given Denominators severally, and multiply each of the given Numer. into the Quotient arising from its own Denominator for each new Numerator.

EXAMPLES.

EXAMPLES.

1. Reduce $\frac{1}{12}$, $\frac{7}{8}$, and $\frac{5}{24}$ to a common Denominator.

$1\times 8\times 24 = 1\times 4\times 2\times 1\frac{1}{2}\times 1\frac{1}{2} = 2$
$7\times 12\times 24 = 7\times 3\times 4\times 1\frac{1}{2}\times 1\frac{1}{2} = 21$ } new Numerators.
$5\times 8\times 12 = 5\times 4\times 2\times 1\frac{1}{2} = 5$
$12\times 8\times 24 = 1\frac{1}{2}\times 4\times 2\times 4\times 6 = 24$ new Denominator.

2. Reduce $\frac{7}{9}$ and $\frac{3}{7}$ to a common Denominator.
3. Reduce $\frac{7}{8}$, $\frac{9}{10}$, and $\frac{11}{12}$, to a common Denominator.
4. Reduce $\frac{7}{9}$, $\frac{9}{20}$, $\frac{5}{14}$, and $\frac{8}{27}$, to a common Denom.
5. Reduce $\frac{2}{3}$, $\frac{1}{3}$ of $\frac{1}{4}$ of $\frac{3}{5}$, and $3\frac{1}{7}$ to a common Denom.

45. *To reduce* Fractions *to equal ones of a different Integer: When a certain No. of the leaſt Integer are equal to one of the greateſt*, Multiply the Numerator by the ſaid No. when the Reduction is to a leſs Integer; but the Denominator by the ſame No. when to a greater.— But

*When a certain No. of the leaſt Integer are not equal to one of the greateſt*, Reduce the given Fraction for a Numerator, and the Integer the Fraction is to be brought to, for a Denominator, both to one Name.

EXAMPLES.

1. Reduce $\frac{5}{6}d.$ to the Fraction of a £.

*Anſw.* $\frac{5}{6\times 12\times 20} = \frac{5}{1440}$ £.

2. Reduce $\frac{5}{1440}$ £. to the Fraction of a Penny?

*Anſw.* $\frac{5\times 20\times 12}{1440} = \frac{1200}{1440} = \frac{5}{6}d.$

3. Reduce $\frac{3}{7}$ of a £. to the Fraction of a Moidore? *Anſw.* $\frac{3\times 20}{7}$ *s.* Numerator, 27*s.* Denom. $= \frac{3\times 20}{7\times 27} = \frac{20}{63}$ Moidore.
4. Reduce $\frac{20}{63}$ of a Moidore to the Fraction of a Pound.
5. Reduce $\frac{3}{4}$ of a Farthing to the Fraction of a Guinea.
6. Reduce $\frac{3}{4}\frac{3}{0}\frac{3}{4}$ of a Guinea to the Fract. of a Farthing.
7. Reduce $\frac{6}{7}$ of a Pound to the Fraction of an Hund. Wt.
8. Reduce $\frac{6}{784}$ of 1 Cwt. to the Fraction of a Pound.
9. Reduce $3\frac{1}{3}$ of a Penny to the Fraction of a Pound.
10. Reduce $\frac{10}{12000}$ of a Pound to the Fraction of a Penny.
11. Reduce $5\frac{1}{2}$ of a Pound to the Fraction of a Tun.
12. Reduce $\frac{11}{4480}$ of a Tun to the Fraction of a Pound.
13. Reduce 13*s.* 4*d.* to the Fraction of £. *Anſw.* $\frac{2}{3}$.
14. Reduce 4*s.* 8*d.* to the Fraction of a Guinea? *Anſ.* $\frac{2}{15}$.

15. Reduce $\frac{5}{6}$ of a Crown to the Fraction of a Shilling.

16. Reduce $^{2}\frac{5}{8}s.$ to the Fraction of a Crown.

17. Reduce 4*qrs.* 14*lb.* to the Fraction of a Tun? *An.* $\frac{8}{160}$.

46. *To reduce a given Fraction to one equal to it that ſhall have a given Numerator or Denominator,* Multiply the given Term of the required Fraction by the contrary Term of the given one; divide this Product by the other Term of the given Fraction, and the Quotient is the Term ſought.

EXAMPLES.

1. Reduce $\frac{3}{4}$ to a Fraction of equal Value, whoſe Numer. ſhall be 15, 34, or 46.

2. Reduce $\frac{4}{5}$ to a Fraction of equal Value, whoſe Denominator ſhall be 20, $45\frac{1}{3}$, or $61\frac{1}{3}$.

47. *When the Numerator or Denominator hath a Fraction annexed, your given Fraction may be reduced to a ſingle one* by multiplying each Term by the Denominator of the fractional Part, and adding the Numerator of the fractional Part to the Term it belongs to.

EXAMPLE.

Reduce $\frac{34}{45\frac{1}{3}}$, $\frac{46}{61\frac{1}{3}}$, and $\frac{21\frac{1}{4}}{45}$ to ſingle Fractions.

48. *To find the Value of a Fraction in Money, Weight, &c.* Multiply the Numerator by the Number of Units of the next inferior Denomination, which are equal to the Integer, and divide the Product by the Denominator; the Quotient is its Value in the ſame Parts you multiplied by: If any Thing remain, proceed with it in the ſame Manner till its Value is found in every Denomination.

EXAMPLES.

1. What is the Value of $\frac{18}{45}$, which you may account the Fraction of a Shilling, a Pound, a Guinea, an Hundred Weight, a Tun, &c.

2. What is the Value of $\frac{3}{32}$ of either a Pound, a Moidore, a Tun, a Yard, a Mile, 10*C.* 1*qr.* 12*lb.* *&c.*

3. What is the Value of $\frac{3}{8}$ of any ſuppoſed Integer, whether Money, Weight, or Meaſure?

4. What is the Value of $\frac{7}{8}$ of a Pound? *Anſw.* 17*s.* 6*d.*

5. What is the Value of $\frac{5}{8}$ of a Guinea? *Anſw.* 13*s.* $1\frac{1}{2}d.$

6. What is the Value of $\frac{28}{112}$ of 10*C.* 1*qr.* 12*lb.* *Anſw.* 8*C.* 1*qr.* 25*lb.* $\frac{1}{112}$.

7. What

7. What is the Value of $\frac{7}{12}$ of a Tun Weight? *Answ.* 11*C.* 2*qr.* 18*lb.* $\frac{2}{3}$.

8. What is the Value of $\frac{7}{9}$ of an Acre? *Answ.* 3*R.* 4*P.* $\frac{4}{9}$.

9. What is the Value of $\frac{5}{9}$ a Year? *Answ.* 202 *Days*, 21 *Hours*, 53 *Minutes*, 51 *Seconds* $\frac{2}{3}$.

## ADDITION of VULGAR FRACTIONS.

49. *To add Fractions*, Reduce compound Fractions to single ones, and *all* to a common Denomination, then to the Sum of the Numerators subscribe the common Denominator, and if it is an improper Fraction, reduce it to its proper Terms. ——— *If mixt Numbers be given*, work the Fractions as above directed, and add the Result to the whole Numbers.

Add $\frac{3}{8}$, $\frac{2}{9}$, and $\frac{4}{7}$ together. *Facit* $1\frac{85}{504}$.
Add $\frac{2}{3}$, $\frac{1}{5}$, and $\frac{4}{7}$ together. *Facit* $1\frac{2}{5}$.
Add $\frac{5}{12}$, $\frac{6}{21}$, $\frac{14}{21}$, and $\frac{19}{21}$ together. *Facit* $2\frac{28}{84}$.
Add $\frac{2}{3}$, $\frac{11}{12}$, $\frac{3}{4}$, and $\frac{48}{63}$ together. *Facit* $2\frac{100}{189}$.
Add $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{1}{4}$ together. *Facit* $2\frac{1}{6}$
Add $\frac{1}{4}$ of $\frac{4}{5}$ of $\frac{3}{4}$ and $\frac{4}{6}$ of $\frac{3}{4}$ together. *Facit* $\frac{13}{20}$.
Add $\frac{2}{3}$ of $\frac{3}{4}$ and $\frac{2}{3}$ of $\frac{5}{6}$ together. *Facit* $1\frac{1}{18}$.
Add $8\frac{1}{2}$, $3\frac{9}{10}$, and $\frac{17}{24}$ together. *Facit* $11\frac{2}{23}$.
Add $\frac{1}{4}$, $\frac{1}{2}$ of $\frac{5}{4}$, and $\frac{3}{4}$ together. *Facit* $1\frac{5}{8}$.

50. *To add or subtract Fractions of Money, Weight, &c.* Reduce them to their proper Quantities by Inst. 48, and then add or subtract as is required.

Add $\frac{7}{8}$ of a Pound and $\frac{1}{2}$ of a Shilling. *Facit* 18*s.*
Add $\frac{1}{2}$ of a Penny and $\frac{2}{7}$ of a Pound. *Facit* 5*s.* 9*d* $0\frac{2}{7}$.
Add $\frac{1}{2}$ of a Pound Troy, and $\frac{7}{12}$ of an Ounce. *Facit* 6*oz.* 11*dwt.* 16*gr.*
Add $\frac{4}{7}$ of a Tun, and $\frac{9}{10}$ of 1 Cwt. *Facit* 12*C.* 1*qr.* 8*lb.* $\frac{4}{7}$.

## SUBTRACTION of VULGAR FRACTIONS.

51. *To subtract Fractions*, prepare them as directed in Addition, and to the Difference of the Numerators subscribe the common Denominator.

From $\frac{1}{2}$ take $\frac{1}{3}$. *Answ.* $\frac{1}{6}$.
From $\frac{7}{8}$ take $\frac{3}{4}$. *Anſ.* $\frac{1}{8}$.
From $\frac{3}{7}$ take $\frac{9}{140}$. *Anſ.* $\frac{237}{700}$.

F. $\frac{2}{3}$ of $\frac{8}{9}$ ta. $\frac{3}{5}$ of $\frac{6}{20}$. *Anſ.* $\frac{147}{270}$.
Fr. $\frac{7}{10}$ take $\frac{1}{6}$ of $\frac{5}{9}$. *Anſ.* $\frac{123}{315}$.
From $\frac{17}{19}$ take $\frac{1}{3}$. *Answ.* $\frac{32}{95}$.

52. *To*

52. *To take a Fraction or mixt No. from a whole No.* Subtract the Numerator of the Fraction from its Denominator, and set the Remainder over the Denominator, then carry one to the Place of Integers in the Subtractor.

From 6 take $\frac{3}{12}$. *Answ.* $5\frac{9}{12}$. | From 17 take $\frac{3}{5}$. *Answ.* $16\frac{2}{5}$.
From 12 take $\frac{5}{8}$. *Answ.* $11\frac{3}{8}$. | From 14 take $6\frac{3}{4}$. *Answ.* $7\frac{1}{4}$.

53. *In subtracting two mixt Numbers when the Numerator of the Subtractor happens to be greatest,* Subtract the said Numerator from its Denominator, and add the Remainder to the Numerator of the least Fraction, carrying one to the Place of Integers in the Subtractor.

From $4\frac{2}{3}$ take $2\frac{3}{4}$. *An.* $3\frac{5}{12}\frac{3}{0}$. | From $17\frac{2}{3}$ take $\frac{3}{5}$. *Anf.* $16\frac{4}{5}$.
Fr. $24\frac{5}{12}$ take $19\frac{6}{10}$. *An.* $4\frac{8}{60}$. | F. $\frac{1}{3}$ of 76 ta. $\frac{4}{7}$ of 21. *A.* $9\frac{7}{12}$

From $\frac{1}{3}$ of a Pound take $\frac{3}{5}$ of a Penny. *Facit* 6*s.* 7*d.* 1*q.* $\frac{2}{5}$.
From $\frac{1}{2}$ of a Pound take $\frac{1}{4}$ of a Shilling. *Facit* 9*s.* 3*d.*

## MULTIPLICATION of VULGAR FRACTIONS.

54 *To multiply Fractions,* Reduce whole and mixt Numbers to improper Fractions, then multiply the Numerators together for the Numerator, and the Denominators together for the Denominator required.

Multiply $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{4}{5}$ together. *Answ.* $\frac{2\times3\times4}{3\times4\times5} = \frac{2}{5}$

Multiply $\frac{9}{10}$ by $\frac{2}{3}$. | Multiply $\frac{4}{8}$ by $\frac{7}{9}$ of $\frac{1}{4}$.
Multiply $\frac{2}{7}$ by $\frac{3}{5}$. | Multiply $\frac{2}{3}$, $\frac{7}{8}$, & $\frac{5}{6}$ together.
Multiply $\frac{23}{49}$ by $\frac{63}{81}$. | Multiply $16\frac{1}{2}$ *l.* by $\frac{4}{12}$.*

## DIVISION of VULGAR FRACTIONS.

55. *To divide Fractions,* Reduce them as in Multiplication, then invert the Terms of the Divisor, and work as there directed.

Divide

* It follows from Inst. 4th, when two Terms are multiplied together that the Multiplier must be considered as an abstract No. Hence we find that to propose multiplying Money, Weights, &c. by Money, Weight, &c. *e. gr.* "$\frac{1}{4}$ Crown by $\frac{1}{8}$ Crown, or 2*s.* 6*d.* by 2*s.* 6*d.*" is absurd; only ask how often the Proposer will have 2*s.* 6*d.* taken: His Answer must be, if the Multiplier is considered an applicate No. 2*s.* 6*d.* (instead of $2\frac{1}{2}$ Times) which shews the Absurdity.— Again,

Suppose 6*s.* 3*d.* were proposed to be divided by 2*s.* 6*d.* and that we ask how often 2*s.* 6*d.* is contained in 6*s.* 3*d.*? The Answer must be, when the Quotient is considered an applicate No. 2*s.* 6*d.* (instead of $2\frac{1}{2}$ Times) which is absurd. Hence in Multiplication and Division of applicate No's. one Term is always an abstract No.

Divide $\frac{3}{5}$ by $\frac{2}{3}$. *Answ.* $\frac{3\times3}{5\times2}=\frac{9}{10}$

| | |
|---|---|
| Divide $\frac{9}{35}$ by $\frac{3}{5}$. | Divide $\frac{6}{81}$ by $\frac{4}{9}$. |
| Divide $4\frac{1}{2}$ by $\frac{1}{8}$. | Divide $7\frac{7}{8}$ by $\frac{1}{2}$ of $\frac{1}{4}$. |
| Divide 4 *l.* by $\frac{1}{4}$ *. | Divide $5\frac{1}{2}$ by $\frac{4}{12}$. |

56. *To find whether any two Fractions are equal, or to find which is the greatest or least*, Multiply each Numerator into the other Denominator, and if the Products are equal, the Fractions are so too, otherwise the Numerator of the greatest Fraction into the Denominator of the other will be the greatest Product.

Find which is the greatest, $\frac{4}{8}$ or $\frac{8}{20}$? *Answ.* $\frac{4}{8}$.

## DECIMAL FRACTIONS.

57. A DECIMAL FRACTION is a Fraction which hath for its Denominator 10 or some Power thereof. The Number of Places in the Numerator must be equal, or made equal, to the Number of 0's in the Denominator; hence the Denominator being known, the Numer. only is wrote down, which to distinguish, and separate from whole Numbers, hath a Point to the Left, thus, $\frac{25}{100}$ is wrote .25, and read two Tenths, five Hundredths, or twenty-five Hundredth Parts; $14\frac{478}{1000}$ is wrote 14.478, and read 14 and 478 Thousandths: Cyphers annexed to Decimals have no Effect, for $5=.50=.500=\frac{5}{10}=\frac{50}{100}=\frac{500}{1000}$. But as Decimal Parts decrease from Left to Right by a tenfold Proportion, so Cyphers, prefixt to Decimals, decrease their Value by the same Proportion;

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*. Mr. Fenning, in Page 99 of his Schoolmaster's Assistant, says, that 4 *l.* divided by $\frac{1}{2}$ Quotes 16 *l.* but this is contrary to his own Definition for Division: The same Author, in Page 45 of his Algebraist's Companion, saith, that $\frac{4}{5}$ of a £. multiplied by $\frac{1}{2}$ of a £. is but $\frac{1}{2}$ of a £. and yet supposes in his School-Assistant that $\frac{1}{2}$ of a £. into itself is 6*s.* 3*d.*

In the first mentioned Example the Divisor is $\frac{1}{2}$, and therefore the Units in the Quotient are so many Quarters of a £. Messrs. Birks, and others, have proposed similar Examples, and have also given false Answers. By the preceding Note you will find that the Error in the two last mentioned Examples arises from the Mode of proposing them; for it is true that $\frac{1}{2}$ of $\frac{4}{5}$ of a £. or $\frac{4}{5}$ of $\frac{1}{2}$ of a £. is 10*s.* and that $2\frac{1}{2}$ Times 2*s.* 6*d.* is 6*s.* 3*d.*, but that $12\frac{1}{2}$ Times 16*s.* is 10*s.* or that $\frac{1}{2}$ of $\frac{1}{2}$ of a £. is 6*s.* 3*d.* no one will affirm.

Proportion; therefore, when the Number of Places in the Numerator are not equal to the Number of 0's in the Denominator, prefix Cyphers to supply the Defect; hence $\frac{14}{1000}$ will be wrote .014, and read 14 Thousandths.

## ADDITION and SUBTRACTION of DECIMALS

58. Are performed in every Respect as in whole Numbers, Regard being had to place all Figures having like Places in one Column, and to set the Punctum of the total Sum or Difference in the Column of Decimal Points.

### Examples.

1. Add 724.2434, 242.9, 242, 342 5424378, 427.484, and 24234.32487, together.
2. Add 24 342, 4247, ·24482, ·0248748, ·023423, and ·00434575, together.
3. Add ·0045, ·2434, ·245, ·003, ·278942, and ·27243, together.
4. Add 27.1487, ·24345, 24.324, ·242435, 42.05, and 407.243, together.
5. Find the Sum of any 8 of the above given Numbers.
6. Find the Difference between any two of the same No's.

## MULTIPLICATION of DECIMALS.

59. In Multiplication of Decimals, write down and Multiply the Factors the same as if they were Integers, and point off as many for Decimals in the Product as there be in both Factors.

Hence if the Product contains less Places than the Factors do Decimals, Cyphers must be prefixt to supply the Defect.

### Example.

Multiply 4524 by ·74, ·42754 by 54, 42,1425 by 7.64, ·04272427 by ·4254, and 4.724 by ·0042534.

### Contractions.

60. *To Multiply by* 10, 100, 1000, *&c.* remove the Decimal Point as many Places to the Right Hand as there are Cyphers in the Multiplier.

### Example.

The Product of 7.4 into 10 is 74.
7.4 into 100 is
7.4 into 1000 is
7.4 into 10000 is

61. *When*

61. *When you desire to retain but a certain No. of Decimals in the Product*, write down the Multiplicand as usual, and under it the Multiplier, inverted with its Units Place, under that Place of the Multiplicand you intend the Product shall extend to; then in Multiplying neglect the Figures in the Multiplicand on the Right Hand of the Multiplying Digit, and write down the first Figure of every Product under each other at the Right Hand, carrying to every Right Hand Figure for what would have been produced by the preceding Figure in the Multiplicand as follows, viz. 1 from 5 to 15, 2 from 15 to 25, 3 from 25 to 35, &c. the Sum of these Products is the Product required.

Multiply .248264 by .725234, and retain 5 Decimal Places in the Product.

| Common Way. | Contracted. |
|---|---|
| .248264 | .248264 |
| .725234 | 432527.0 |
| 993056 | 17378 |
| 744792 | 497 |
| 496528 | 124 |
| 124 1320 | 5 |
| 496 528 | |
| 17378 84 | .18004 |
| .18004 \| 9493776 | |

Multiply 580.67639 by .30976, by 26.2679168, and by 18.667891, retaining either 3, 4, 5, &c. Decimals in the Product.

## DIVISION of DECIMALS.

62. In Division of Decimals, divide as in Integers, and cut off as many Figures for Decimals in the Quotient, as when added to those in the Divisor do make the same Number as the Dividend contains.—— Hence

When the Decimal Places in the Dividend are equal (or made so by Cyphers) to those in the Dividend, the Quotient will be Integral.—— Hence also,

When Division is finished, and Decimal Places are wanting in the Quotient, 'tis plain that the Defect must be supplied by Cyphers.

*Note* 1. When all the Dividend Figures are used, and there is a Remainder, continue the Division by adding Cyphers to every last Remaind.

2. The first Quotient Figure is of the same Value as that Figure in the Dividend, under which the Units Place of said Quotient Figure into the Divisor stands.

EXAMPLES.

EXAMPLES.

| | |
|---|---|
| 16.4)890.0936( | 48.97)188.0668( |
| 1750)1330.00 ( | .52).39416 ( |
| .475)9 025 ( | 8.45)295.75 ( |
| 283).154605 ( | 2.83).154605 ( |
| 3)1.00 ( | 3172)15.7300 ( |

63. *When the Diviſor is* 10, *or a Power thereof, or any Integers with Cyphers annexed*, remove the Decimal Point ſo many Places to the Left Hand as there are Cyphers in the Diviſor, and you have the Quote by 10, 100, &c. which divided by the Integers, when given, give their Quote.

Divide 254 by 10, or a Power thereof, by 275000, 38000, and by 25000, 28000, 32000, &c.

64. *When the Number of Decimal Places in the Diviſor and Dividend is great*, the Work may be contracted thus: Having found of what Denomination the firſt Quotient Figure will be, conſider how many Places in the Quote will be ſufficient, then take the ſame No. of Left-hand Places in the Diviſor, and ſo many Places in the Dividend on the Left as will contain them, leſs than 10 Times; with theſe find the firſt Quotient Figure, and divide every laſt Remainder by the laſt Diviſor, having its Right-hand Figure omitted, having a due Regard to the Increaſe, which would have ariſen from the Figure ſo omitted.

*Note*, If there are not ſo many Places in the Diviſor as you want in the Quote, perform Diviſion as uſual, till the No. of Figures in the Diviſor, and thoſe remaining to be found of the Quote, are equal; then uſe the Contraction.

Divide .18004949776 by .248264, retaining 4 Decimal Places in the Quote.

0.24826).18004,949776(.7252

626

129

5

0

Divide 4108.2873, by 27245.2 by 3.141523 by 2048.32, and by .278, ſo that the Quote may contain any given No. of Places, or a given No. of Decimals.

REDUCTION

## REDUCTION of DECIMALS.

65. *To reduce a Vulgar Fraction to its equal Decimal one,* Divide the Numerator by the Denominator by Division of Decimals.*

EXAMPLE.

Reduce $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{13}$, $\frac{2}{9}$, $\frac{23}{453}$, and $\frac{37}{274}$ to Decimals.

66. *To reduce Integers or Decimals, or a compound Number to equal Decimals of superior Denomination.*

*If it be a simple No. or Decimal,* Reduce it to the required Name by dividing as in Reduction of Integers. But

*If it be a compound No.* add Cyphers to the given No. of the lowest Denomination, and divide by so many Units as make 1 of the next Higher: On the Left of the Quotient set the given Units of the next superior Denomination, and divide by so many Units as make one of the next Higher; proceeding thus to the highest Name, the last Quote is the Decimal sought.

EXAMPLES.

1. Reduce $1\frac{1}{2}d$, $3d$, $6d$, and $9d$, to the Decimal of 1 £. The Answers are .00625, .0125, .025, and .0375 £.

2. Reduce .125, .25, .5, .75, &c. which you may account as Decimals of a Penny. of an Ounce Troy, of a Pound Avoirdupoize, or of any inferior Name of one Species, to the Decimal of a Pound, of a Pound Troy, of an Hundred Wt. or of any superior Name of a like Species.

6. Reduce $9s$. $9\frac{6}{7}d$. to the Decimal of a £. *Ans.* .489583, &c. Pound.

4. Reduce $7oz.$ $13dwt.$ $19gr.$ to the Decimal of a Pound? *Answ.* .64079861, &c. Pound.

5. Reduce

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* To bring a Vulgar Fraction, which hath for its Denominator a Prime No. greater than 12, into a Decimal, sooner than by the above Rule, proceed as in the following Example: "Suppose the Decimal of $\frac{1}{29}$ was required; I divide in the common Way to find 2 or 3 of the first Figures, or till the Remainder becomes a single Figure: Thus I have $\frac{1}{29}$=.03448 $\frac{8}{29}$. But as $\frac{1}{29}$=.03448 $\frac{8}{29}$ the Remainder $\frac{8}{29}$ will be =.03448$\frac{8}{29}$ × 8=0.27586$\frac{6}{29}$, this I substitute for $\frac{8}{29}$, & $\frac{1}{29}$ becomes =0.034482758$6\frac{6}{29}$, again I multiply the last found Value of $\frac{1}{29}$ by 6, and it gives $\frac{6}{29}$ = .206896551$7\frac{7}{29}$, and then by Substitution $\frac{1}{29}$=.0344827586206896551$7\frac{7}{29}$, where every Operation doubles the No. of Figures found by the preceding One."

5. Reduce 3*qrs.* 14*lb.* to the Decimal of a Tun? *Answ.* .04375 Tun.

6. Reduce 6*oz.* 2*drs.* to the Decimal of a Pound? *Answ.* .3828125 Pound.

7. Reduce 14 *Acres*, 1*R.* 20*P.* to Acres? *Answ.* 14.375.

8. Reduce 2*R.* 18*P.* to the Decimal of an Acre? *Answ.* .6125.

9. Reduce $3\frac{1}{2}$ Gallons of Beer, *London*, to a Hogshead? *Answ.* .064814, &c. Hogshead.

10. Reduce 3 Days 14 Hours to the Decimal of a Week? *Answ.* .5119, &c. Week.

11. Find the Decimal of any of the given Answers in the next Inst.

67. *To find the Value of a Decimal Fraction*, is the Reverse of the former, ∴ Multiply continually by the No. of Units in every next lower Name, pointing off in every Product so many Decimals as are in the given one; the Figures on the Left of the Points, with the Decimals pointed off in the last Product (if any) are the Answer.

EXAMPLES.

1. Find the Value of any or all the Answers in the last Inst?

2. What is the Value of .7625 Pound St. *Answ.* 15*s.* 3*d.*

3. What is the Value of .884375 P. St. *Answ.* 17*s.* $8\frac{1}{2}$*d.*

4. What is the Value of .68125 Mile? *Answ.* 5*F.* 18*P.*

5. What is the Value of .85 Cwt. *Answ.* 3*qr.* 11*lb.* 3.2*oz.*

6. What is the Value of .985 Barrel of Ale in the Country? *Answ.* 33 *Gal.* 1.96 *Quarts.*

7. What is the Value of .35 Hogshead of Wine? *Answ.* 22.05 *Gallons.*

8. What is the Value of .15625 Acre of Land? *Answ.* 25 *Poles.*

68. Shillings, Pence, &c. may be turned into Decimals of a Pound, by considering that $\frac{1}{10}$ of a £. being 2*s.* every even No. of *S.* will be expressed by their Half in the first Decimal Place, and $\frac{1}{100}$ of a £. being = 1*s.* that 5 in the 2d Place will express 1*s.*; but as 48 Farthings, and not 50, make 1*s.* ∴ for every 6*d.* or 24 Farthings 1 must be added in the 3d Place, hence any No. of Farthings divided by 24, or multiplied by its reciprocal .04$\frac{1}{6}$, will quote their Correction, which being added gives the true Decimal.

EXAMPLES.

EXAMPLES.

What is the Decimal of $5\frac{1}{4}d$, of 17*s*. $8\frac{1}{4}d$., of $9\frac{3}{4}d$., and of 14*s*. $11\frac{1}{4}d$., one Pound Sterling being the Integer.

69. The Value of any Decimal of a Pound Sterling may be found by doubling the Figure next the Point for Shillings, and if the Figure in the second Place be greater than 4, take 5 from it for one Shilling more, and for every 25 which remains in the 2d and 3d Places throw away 1, the rest will be Farthings.

What is the Value of .0239583, &c. .884375, .040625, and .746875 of a £.

## *Of the* Ratio's of Numbers, *and of* Proportion.

70. IN considering the Comparison Numbers have to each other, the Terms proposed must be two, of which that which is compared or wrote first is called the *Antecedent*, and the other which it is compared to, the *Consequent*. Numbers may exceed one another both by Addition and Multiplication, and ∴ two Sorts of Ratio's will arise; the one which considers their Difference, called *Arithmetical Comparison* or *Ratio*, the other their Quotient, named *Geometrical Ratio*.

71. When 2 or more Pairs of Numbers have = Ratio's or Differences, the Equality is called *Proportion*, and the No's. *Proportionals*, so 2, 4, 6, 8, are *Arithmetical Proportionals* where the Difference between any two contiguous Terms is equal: So also 2, 4, 8, 16, are *Geometrical Proportionals*, in which the Quotient of any two contiguous Terms is equal.

*Proportion may be continual or discontinual.*

72. If there be such Numbers that the first hath the same Comparison to the second, as the second to the third, and as the third to the fourth, &c. these Numbers are *continual Proportionals*, so 1, 3, 5, 7, 9, &c. are *continual Arithmetical*, and 2, 4, 8, 16, 32, &c. are *continual Geometrical* Proportionals.

73. But if the Ratio's are taken between such Pairs of No's as do not stand together or immediately follow each other in the Series, then is the Proportion *discontinued*, so 1, 3, 7, 9, are in *discontinued Arithmetical*, and 2 : 4 :: 16 : 32 in *discontinued Geometrical* Proportion.

74. Now in Geometrical Proportion the Product of any two Means when the Terms are equal, will be equal to the Product

Product of any two Terms equi-diſtant from theſe Means, as is plain from the following Series, 2, 4, 8, 16, = 2, 2×2, 2×2×2, 2×2×2×2, from whence if 3 of theſe Terms are given, 'tis manifeſt that a fourth may be found by making the leaſt Extreme Diviſor when a greater Term is required; or the greateſt Extreme Diviſor when a leſs Term is required, to the Product of the other two Terms.

*Note*, The firſt and laſt Terms of a Progreſſion are called Extremes, the others Means.

## *Of the* RULE OF THREE.

75. THIS Rule is ſo called from having three Terms given to find a fourth.

In ſtating Queſtions, put that Term of the ſame Name with that ſought in the *Middle*, the Relative of that Term in the *firſt Place*, and the remaining Term in the *third Place*.

Reduce the firſt and third Terms to one Name, the Middle may, or may not, be reduced.

If the Anſwer is to be greater than the Middle Term, the leaſt Extreme muſt be Diviſor to the Product of the other Terms; but if the Anſwer is to be leſs than the Middle Term, the greateſt Extreme muſt be Diviſor to the Product of the other Terms; the Reſult is the Anſwer of the ſame Name your Middle Term was brought into.

*Note* 1. The firſt and third Terms are called Extremes.

2. If any Thing remains after Diviſion, proceed as directed in Inſt. 48.

3. Your Diviſor being the firſt Term, (or made ſo) and that of the ſame Kind the Third, either of the following Rules gives the Anſwer, *viz.*

Rule 1. Divide the 2d Term by the 1ſt, and multiply the Quote into the 3d for the Anſwer.

Rule 2. Or Divide the 1ſt Term by the 2d, and divide the 3d by the Quote.

Rule 3. Or Divide the 3d by the 1ſt, and multiply the Quotient into the 2d.

Rule 4. Or Divide the 1ſt Term by the 3d, and divide the 2d by that Quote for the Anſwer.

*Note* 4. The Term which is Diviſor bears the ſame Geometrical Compariſon to the Middle Term as the other Term to the Anſwer. Hence this Rule is called the *Rule of Proportion*, and ſometimes, to denote its Excellency, *The Golden Rule*.

EXAMPLES.

EXAMPLES.

1. If 4 Yards coſt 5*s.* what coſt 48 Yards?
2. If 48 Yards coſt 3*l.* what coſt 4 Yards?
3. If 5*s.* buy 4 Yards, what No. of Yards will 3*l.* buy?
4. If 3*l.* purchaſe 48 Yards, what will 5*s?*
5. If a Yard coſt $7\frac{1}{2}d.$ what coſt 239 Yards? *Anſw.* 7*l.* 9*s.* $4\frac{1}{2}d.$
6. At 1*l.* 14*s.* 1*d.*, at 4*l.* 13*s.* 7*d.*, at 5*l.* 14*s.* 5*d.*, at 14*l.* 19*s.* $11\frac{3}{4}d.$, at 7*l.* 19*s.* $11\frac{3}{4}d$, and at 17*l.* 8*s.* $2\frac{1}{4}d.$ per Bag of Hops, what coſt 742 Bags? [*See the Anſwers at Inſt.* 82.]
7. If 1*lb.* of Pepper coſt $6\frac{1}{2}d.$ what coſt 114*lb*. *An.* 3*l.* 1*s.* 9*d.*
8. If a Buſhel of Coals coſt 1*s.* $10\frac{1}{2}d.$ what coſt 7200 Quarters? *Anſw.* 5400*l.*
9. If 18 Yards in Breadth require 32 Yards in Length, to line a Carpet, what will 3 Quarters in Breadth require in Length to line the ſame Carpet? *Anſw.* 768 Yards.
10. If a Gallon of Brandy coſt 7*s.* 2*d.* what coſt 248 Hogſheads? *Anſw.* 5598*l.* 12*s.*
11. If 1*lb.* coſt 5*d.* 7*d.* 11*d.* 13*d.* 17*d.* 19*d.* $4\frac{1}{4}d.$ $6\frac{1}{2}d.$ $11\frac{1}{2}d.$ $22\frac{1}{2}d.$ 14*s.* 7*d.* or 15*s.* 11*d.* what coſt 6*C.* 2*qrs.* 14*lb.* at each of the ſaid Rates? [*See theſe Anſwers at Inſt.* 81.]
12. If 1 *C.* of Tobacco coſt 2*l.* 16*s.* what coſt 10*C.* 1*qr.* 14*lb?* *Anſw.* 45*l.* 17*s.*
13. If 1 *Cwt.* of Currants coſt 2*l.* 9*s.* 6*d* what coſt 45*C.* 3*qrs.* 14*lb?* *Anſw.* 113*l.* 10*s.* $9\frac{3}{4}d.$
14. At 4*l.* 12*s.* 6*d. per Cwt.* what coſt each of the following Quantities, to wit, 4*C.* 2*qrs.* 14*lb.*, 11*C.* 3*qrs.* 7*lb.*, 21*C.* 1*qr.* 5*lb.*, 14*C.* 2*qrs.* 14*lb.* and 4*T.* 11*C.* 1*qr.* 5*lb?* [*See the Anſwers at Article* 83.]
15. If an Ell Engliſh coſt 2*s.* $1\frac{1}{2}d.$ what coſt 1172 Yards? *Anſw.* 99*l.* 12*s.* 4*d.* 3*q.* $\frac{1}{5}$.
16. If a Servant's Wages come to 7*l.* per Annum, what for 54 Days? *Anſw.* 1*l.* 0*s.* 8*d.* 2*q.* $3\frac{70}{73}$.
17. If a Firkin of Butter coſt 18*s.* what per Pound? *Anſ.* 3*d.* 3*q.* $\frac{24}{56}$.
18. How long will 1000*l.* laſt me if I expend 3*s.* 6*d.* per Day? *Anſw.* 15 Years, $239\frac{12}{42}$ Days.
19. If 14 Hogſheads of Tobacco, containing 82 *C.* 3*qrs.* 17*lb.* coſt 619*l.* 10*s.* what coſt 1*lb?* *Anſw.* 1*s.* 4*d.* $\frac{480}{9285}$.
20. How many Yards of Lace for 100*l.* at 3*s.* 6*d.* a Yard? *Anſw.* 571 $\frac{3}{7}$.
21. A Trader failing owes 6700*l.* but is worth only 2900*l.* what can he pay per Pound? *Anſw.* 8*l.* 7*s.* 3*d.* $\frac{25}{67}$

22. How

22. How many Yards of Cloth for 21*l.* 10*s.* $1\frac{1}{2}$*d.* at 15*s.* 6*d.* per Yard? *Anſw.* $27\frac{3}{4}$.

23. Bought a Piece of Cloth for 16*l.* 10*s.* at 15*s.* a Yard, how many Yards did it contain? *Anſw.* 22.

24. If I buy 115*C.* 1*qr.* 12*lb.* of Madder for 145 *l.* what Weight may I buy for 120*l.*? *Anſw.* 95*C.* 1*qr.* $24lb.\frac{69}{145}$.

25. If 39 Yards of Cloth coſt 2*l.* 2*s.* 3*d.* how many for 14*s.* 1*d.* *Anſw.* 13 *Yards.*

EXAMPLES *wherein* Addition *is to be performed before the Proportion can be found.*

26. Suppoſe a Seaman ſailed in a Veſſel from the 11th of July, 1767, to the 31ſt of Auguſt, 1768, what Wages is due to him, at 25*s.* per Month, allowing 30 Days to the Month? *Anſw.* 17*l.* 8*s.* 4*d.*

27. If 100*lb.* of Cloves coſt 88*l.* 11*s.* 10*d.* and 1 *Cwt.* of Mace 99*l.* 10*s.* 3*q.* what coſt 3 Ounces one with another? *Anſw.* 3*s.* $3d\ \frac{3}{3}\frac{1}{3}\frac{4}{9}\frac{7}{2}$.

SUBTRACTION *before the* Analogy *is found.*

28. If Tobacco be bought for $13\frac{1}{2}$*d.* and ſold again for 16*d.* per Pound, what is gained per Cent? *Anſw.* 18*l.* 10*s.* 4*d.* 1*q.* $\frac{7}{9}$.

29. If I have an Eſtate of 470*l.* per Annum, what may I expend daily, and yet lay up 100*l.* a Year? *Anſw.* 1*l.* 0*s.* 3*d.* 1*q.* $\frac{55}{365}$.

MULTIPLICATION *before the* Analogy *can be found.*

30. If 24*lb.* of Raiſins coſt 6*s.* 6*d.* what will 18 Frails coſt, each weighing 3*qrs.* 18*lb*? *Anſw.* 24*l.* 17*s.* 3*d.*

31. If a Dozen Ells of Holland coſt 13*s.* 4*d.* what coſt 8 Pieces, each 47 Yards? *Anſw.* 4*l.* 3*s.* $6\frac{2}{3}$*d.*

DIVISION *before the Proportion is found.*

32. If $\frac{1}{5}$ of 2*l.* 2*s.* 10*d.* buy 2*C.* 2*qrs.* 27*lb.* what will $\frac{1}{8}$ of 475*l.* buy? *Anſw.* 64*T.* 9*C.* 0*qr.* $13lb.\frac{76}{464}$.

33. If $\frac{3}{4}$ of 5*l.* 10*s.* buy $5\frac{1}{2}$ Yards, what will $\frac{3}{8}$ of 547 *l.* buy? *Anſw.* 273*T.* 2*qr.*

ADDITION *after the* Proportion *is found.*

34. A Grocer bought 3*C.* 1*qr.* 14*lb.* of Cloves, at 2*s.* 4*d.* per Pound, and he gained 8*l.* 12*s.* by the Sale of them, what were they ſold for? *Anſw.* 52*l.* 14*s.*

35. Bought 4*C.* 2*qrs.* 14*lb.* of Cinnamon, at 50*l.* per *C.* what muſt I ſell it for to gain 40*l.* on the Whole? *Anſw.* 271*l.* 5*s.*

SUBTRACTION

SUBTRACTION *after the* Analogy *is found.*

36. A Merchant buys 15*hhd.* 18*g.* of Wine, at 4*s.* 8*d.* per Gallon, and pays in Part 14*l.* 14*s.* what remains due? *Anſ.* 210 *l.*

37. If a Piece of Graſs graze 56 Ozen 6 Days, how many muſt be turned out that it may laſt the remaining Oxen 16 Days? *Anſw.* 35.

MULTIPLICATION *and* DIVISION *after the* Analogy *is found.*

38. How many Yards, Quarters, and Nails, will 4074 Guineas, 14 Shillings and Four-pence buy at 4*s.* 9*d.* per Yard? *Anſw.* 18014 *Y.* 1*qr.* 2*na.* $\frac{10}{57}$.

39. There are two Numbers, (the greateſt is 459) which are to each other as 3 to 9, what is their Product? *A.* 70227.

40. There are two Numbers, the leaſt being 95, which are to each other as 5 to 7, what is the Quotient of the Greateſt divided by 4? *Anſw.* 33$\frac{1}{2}$.

41. How many Yards, Quarters, and Nails, will 4075 *l.* 14*s.* buy, at 2*s.* 4*d.* per Nail? *Anſw.* 2183 *Y.* 1*qr.* 2*na.* $\frac{4}{7}$.

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42. How many Pounds of Coffee, at 5*s.* 9*d.* are equal in Value to 426 of Tea, at 13*s.* 4*d.* per Pound? *Anſ.* 987$\frac{19}{23}$.

43. If for 24*s.* I have 10 *C.* 2*qr.* 24*lb.* carried 36 Miles, how much Weight may I have carried 24 Miles for the ſame Money? *Anſw.* 16*C.* 0*qrs.* 8*lb.*

44. If when Wheat is 4*s* per Buſhel the 20*d.* Loaf weighs 18*lb.* what ought it to weigh when Wheat is 6*s.* 6*d.* *Anſw.* 11*lb.* $\frac{3}{39}$.

# COMPOUND PROPORTION;

## OR

## THE RULE OF FIVE.

76. THIS Rule is ſo called from its having 5 Terms given to find a 6th: 'Tis named the *Double Rule of Three*, becauſe it includes, and ſometimes is performed by, two Operations of the Rule of Three; when both theſe Statings are direct, they call it the *Double Rule of Three Direct*; but when either Stating is Inverſe, *The Double Rule of Three Inverſe.*—— But as compound Queſtions, ſolvable by this Rule, may have more than 5 given Terms, obſerve to put the Term of

ven Months, what is each Man to ſuſtain of this Loſs? *Anſ.* *K* 9*l* 10*s*, *L* 9*l* 16*s*, and *M* 7*l*.

I ſhall conclude this Rule with obſerving, that you may find the Sum of the Gain or Gains of all the Partners, except one, and take from the whole Gain for the other Gain.

## EXCHANGE.

124. BY Exchange we here mean the Exchanging the Money of one Country for another. The Method of computing what Quantity of the Money of one Country muſt be given for a certain Sum of another, at any given Courſe, or Rate of Exchange, is eaſy from the foregoing Rules.

125. It muſt be conſidered, that a Nation which hath the Ballance of Trade in its Favour, & imports Specie from another, renders Money at Home more valuable Abroad; on the contrary, When the Ballance is againſt a Nation, and their Specie is Exported, it becomes thereby leſs valued abroad.

Hence the *Courſe*, or *current Rate* of Exchange, betwixt any two Countries, riſes and falls according to the Plenty or Scarcity of Money or Bills, tho' it is ſometimes according to the Time allowed for Payment, &c. But the *Par* of Exchange, *i. e.* the real Value of any foreign Piece or Sum, being always according to the Weight and Fineneſs of the Coin, remains fixed.—— Hence alſo,

If you will negotiate with Advantage, 'tis plain that you muſt remit when the Exchange is low, and draw again when it is high: And this will more plainly appear if it be conſidered that 100 *l.* will purchaſe more Crowns, &c. when the Exchange is at 32*d.* than when it is at 40*d.* and 100 Crowns, or their Value, will be a Draught of more Worth when the Exchange is at 40*d.* than when it is at 32*d.* per Crown.

*Note*, The Word *Agio* is particularly made Uſe of in Amſterdam, Venice, &c. and denotes the Difference between the Value of Bank Stock, Bills, or Money of the Bank, and their current Coin.

The chief Places with which England Exchanges, are, Holland, Flanders, Hamburgh, France, Portugal, Spain, Italy, Ireland, America, &c.

### 1. With Holland, Flanders, &c.

At moſt Places within theſe Countries, Accompts are kept in Guilders, Stivers, and Penningens, or Phennings; at others

others in Pounds, Shillings, and Pence, as in England: Their Money is diſtinguiſhed by the Name *Flemiſh*, and England reckons 1 *l.* Sterling for a No. of Shillings and Pence *Flemiſh*, which No. is, according as the Courſe of Exchange is, at the Time of the Negotiation.

*Note*, 2 Pence or Grotes, or 26 Phennings make 1 Stiver; 12 Pence, or 6 Stivers, 1 Shilling; 20 Stivers a Guilder or Florin; and 20 Shillings, or 6 Guilders, 1 *l. Flemiſh*, worth at Par, at the Bank of *Amſterdam*, Agio being 5 per Cent. 10*s.* 11$\frac{1}{3}$*d.*

EXAMPLES.

1. What will 397*l.* 15*s.* Sterling amount to in Guilders, Stivers, and Phennings, Exchange at 34*s.* 8*d.* Flemiſh for 1*l.* Sterling?

2. What will 4136 Guilders, 12 Stivers, amount to in Sterling Money, Exchange at 34*s.* 8*d. Flem.* for 1*l. Sterling?*

3. What will 4000 Guilders amount to in Sterling Money, Exchange at 33*s.* 8$\frac{1}{2}$*d. Flemiſh* for 1*l.* Sterling?

4. What will 395*l.* 11*s.* Sterling amount to in Guilders, &c. Exch. at 33*s.* 8$\frac{1}{2}$*d. Flemiſh* for 1*l.* Sterling?

5. Change 56*l.* 6*s.* 9*d.* Sterling into Flemiſh Pounds, &c. Exchange at 35*s.* 6*d?*

6. Change 100*l. Flemiſh* into *Sterling*, Exchange at 35*s.* 6*d?*

2. With HAMBURGH.

127. Accompts are kept at the Bank in *Hamburgh*, and by moſt People in Marks, Schilling-Lubs, and Phennings: But ſome keep them in Pounds, Shillings, and Pence: The Exchange between this Place and England is negotiated at ſo many Flemiſh Shillings, &c. for 1*l.* Sterling, as in Holland.

*Note*, 12 Fenins make 1 Lubiſh Skilling, and 16 Lubiſh Skillings 1 Mark.—— Alſo, 6 Fenins-Lub make one Grote or Penny Flemiſh; 6 Lubiſh Skillings, otherwiſe Shillings or Stivers, 1 Skilling Flemiſh, and 7$\frac{1}{2}$ Marks one Pound *Flemiſh*.=12*s.* 3*d.* Sterling.

EXAMPLES.

1. What will 6262 Marks, 7 Schillings, 9 Phennings, Bank Money of *Hamburgh*, amount to in Sterling Money, Exchange at 34*s.* 11$\frac{1}{2}$*d.* Flemiſh, for 1*l.* Sterling? *Anſw.* 477*l.* 14*s.* 2$\frac{2}{3}$*d.*

2. Change 3469 Marks, 4 Skillings, 3 Phennings, Bank Money of *Hamburgh*, into Sterling Money, Exchange at either

32$\frac{1}{2}$*s.* or 34*s.* 2*d*$\frac{1}{2}$. Flemiſh, for 1*l.* Sterling? *Anſwers* are, 286*l.* 2*s.* 6*d.* and 309*l.* 19*s.* 4$\frac{1}{2}$*d.*

### 3. With France.

128. Accounts are kept in Livres, Sols, and Deniers in all this Kingdom, except at *Dunkirk*, and a few other Places. The French uſe the Word *Turnois* to diſtinguiſh their Money from others, in the ſame Manner as we uſe the Word *Sterling*: And they Exchange upon the Crown of 3 Livres, worth at Par, in 1762, 2*s.* 5$\frac{1}{4}$*d.* Sterling.

*Note,* 12 Deniers make one Sols or Sous, and 20 Sous 1 Livre.

#### Examples.

1. What Sterling Money will anſwer a Bill of 2268 French Crowns, Exchange 52*d.* per Crown? *Anſw.* 491*l.* 8*s.*

2. What Sterling Money will 1134 French Crowns amount to, at either 26*d.* or 30$\frac{1}{3}$*d.* Sterling per Crown? *Anſw.* 122*l.* 17*s.* and 143*l.* 6*s.* 6*d.*

3. At either 29$\frac{1}{4}$*d.* or 30$\frac{1}{3}$*d.* per French Crown, what will a Bill of 143*l.* 6*s.* 6*d.* amount to in Livres, Sols, and Deniers? *Anſw.* to the firſt Rate, 1275$\frac{1}{4}$ *Livres*; to the ſecond, 1134 *Livres.*

### 4. With Portugal.

129. In *Liſbon*, *Oporto*, &c. they keep their Accompts in Reas, of which 480 make 1 Cruzado, and 4 Mil 800 Reas, or 4800 Reas 1 Moidore: The Exchange between this Kingdom and *England* is negotiated moſtly upon the Mil-Rea, which is worth, at Par, 5*s.* 7$\frac{1}{6}$*d.* Sterling.

#### Examples.

1. In 2729 Cruzadoes, 372 Reas, what Sterling Money, Exchange at 62 *d.* per Mil, or 1000 Rees? *Anſw.* 338*l.* 9*s.* 10*d.*

2. How many Mil-Reas, at 5*s.* 7$\frac{1}{4}$*d.* may be had for either 277*l.* 6*s.* 3*d.* or 1386*l.* 11*s.* 3*d.* Sterling? *Anſw.* for the firſt Sum 986, for the ſecond 4930.

3. How many Cruzadoes, Exchange at 62*d.* per Mil-Rea, may be had for either 676*l.* 19*s.* 8*d.* or 1353*l.* 19*s.* 4*d*? *Anſ.* for the firſt Sum 5459 Cruzadoes 264 Reas, for the ſecond, 10919 Cruzadoes, 48 Reas.

### 5. With Spain.

130 Accounts are kept in *Spain* ſeveral Ways: But at moſt of the principal Places they are kept in Piaſtres, Rials, and

and Maravedies: The *Spanish* Exchange on the Piastre, worth 43*d*., Ducat, &c.

| | |
|---|---|
| *Note*, 4 Maravedies Vellon, or 2½ Maravedies of new Plate, | make 1 Quartas. |
| 8½ Quartas, or 34 Maravedies Vellon, | 1 Rial Vellon. |
| 16 Quartas, or 34 Maravedies, new Plate, | 1 Rial new Plate. |
| 8 Rials of new Plate, 512 Maravedies Vellon, 128 Quartas, or 15 Rials 2 Maravedies Vellon, | 1 Piastre of Exchange. |

EXAMPLES.

1. In 572*l*. 18*s*. 9*d*. how many Piastres, Exchange at 42¼*d*. per Piastre? *Answ.* 3225 Piastres, 7 Rials, 13 Mar.

2. In 2377*l*. 4*s*. how many Ducats, at either 49 or 56*d*, each? *Answ.* at the first Rate 11461½, at the second 10188.

3. How many Pistoles, at 14*s*. 4*d*. each, may be had for 288*l*. 16*s*? *Answ.* 402½⅓=402 *Pist.* 31 *R.* 8⅓ *M.*

## 6. With ITALY.

131. At *Genoa*, *Leghorn*, &c. Accounts are kept in Pezzo's, or Piastres, Soldi and Denari, and in Lires, Soldi, and Denari, reckoning 12 Deniers to 1 Soldi, 20 Soldi to 1 Lire, 100 Soldi, or 5 Lires to the Pezzo or Piastre of Exchange of *Genoa*, and 120 Soldi, or 6 Lires to the Piastre of Exchange of *Leghorn*; that of *Genoa* being worth 50*d*. Sterling, and this of *Leghorn* 51½*d*.

132. At *Venice* Accounts are kept in Ducats and Gross Banco, reckoning 24 Gross to a Ducat, or in Livres, Soldi, and Deneri, Current Banco, reckoning as in *Genoa*, &c. The Ducat is often divided into 20 Sols d'Or, and each Sol into 12 Deniers d'Or, and some keep their Accounts in Ducats, Sols, and Deniers d'Or. The Ducat Banco is worth, at Par, about 52*d*. Sterling.

EXAMPLES.

1. Change 720*l*. 10*s*. into Piastres, Exchange at 55*d*. per Piastre? *Answ.* 3120 Piastres.

2. Change 4000 Ducats in Sterling Money, Exchange at 52*d*. per Ducat? *Answ.* 866*l*. 13*s*. 4*d*.

3. In 471 Piastres, 6 Soldi, 3 Deneri of Leghorn, how much Sterling Money, Exchange at 4*s*. 2*d*. per Piastre? *Answ.* 98*l*. 2*s*. 8$\frac{87}{144}$*d*.

### 7. With IRELAND, AMERICA, &c.

133. In *Ireland*, and our Colonies in *America*, and the *West Indies*, Accounts are kept in Pounds, Shillings, and Pence, divided as in *England*: And in *Ireland* they Exchange by the Pound Sterling, worth at Par 108*l.* 6*s.* 8*d.* sterling.

EXAMPLES.

1. *London* remits to *Dublin* 300*l.* 12*s.* what must be received there in *Irish*, Exchange at 110*l.* *Irish* for 100*l.* sterling? *Answ.* 330*l.* 13*s.* $2\frac{3}{4}$*d.*

2. *London* remits to *Ireland* 900*l.* Exch. 1*s.* sterling, for 13*d.* *Irish*, what doth this Remittance amount to in *Irish* Money? *Answ.* 975*l.*

3. *Ireland* remits to *London* 900*l.* Exchange at the same Rate as last Exam. what doth the Remittance amount to in sterling Money? *Answ.* 830*l.* 15*s.* 4*d.* $2\frac{6}{13}$.

4. *London* remits to *Jamaica* 800*l.* Exchange, at 14*s.* 3*d.* sterling for 1*l.* of *Jamaica*, what must be received for it of *Jamaica* Currency? *Answ.* 1122*l.* 16*s.* 1*d.* $2\frac{12}{17}$.

134. *To turn current Money into Bank Money:* As 100 with its Agio added: 100:: any given Sum Current: its Value Banco: On the Contrary: As 100: 100 with its Agio added :: any given Banco: its Value Current.

☞ It will be often found useful in Questions of the Rule of Three to throw out both of the Divisor and the Terms multiplied together for a Dividend; those Numbers, or their component Parts, which are alike, and in many Examples if the Divisor and Dividend are not composed to each other, it may be better to divide with some Number, and work with their Quotient.

EXAMPLES.

1. Change 4558 *Guilders*, 2 *St.* 2 *P.* Current, into Bank Money, Agio at $3\frac{1}{8}$ per Cent?

2. Change 4420 Guilders of the Bank into Current Money, Agio at $3\frac{1}{8}$ per Cent?

3. In 3400 Florins current, Agio 5 per Cent. how many Pounds sterling, Exch. at 35*s.* 10*d.* Flem. for 1*l.* sterling? *Answ.* 301*l.* 4*s.* 4*d.* $1\frac{31}{121}$.

4. In 3228 Guilders, 1 Stiver, $14\frac{10}{21}$ Penins Banco, Agio at 5 per Cent. how many Pounds sterling, Exch. at 35*s.* 10*d.* and how much current Money?

## QUESTIONS,

*Wherein the Gain or Loss in Exchange is required.*

1. *London* remits to *Amsterdam* a Sum of Money at 35*s.* 3*d.* Flemish for 1*l.* Sterling, with Intent to take the Opportunity of

of the Course, to draw the said Sum back again: In about one Month after this Remittance was made, the Course between *London* and *Amsterdam* is 34*s.* 7*d.* *London* takes the Opportunity of this last Course to draw upon *Amsterdam* for the Sum remitted thither. The Query is, How much per Cent. *London* gains by this Negotiation? *Answ.* 2*l.*

2. If a Merchant draws at 35*s.* 3*d.* and remits at 37*s.* 2*d.* *Flemish* for 1*l.* sterling, what doth he gain per Cent? *Answ.* 5*l.* 7*s.*

3. *A* of *London* drawe upon *B* of *Paris* for 200 Crowns, at 2*s.* 6*d.* sterl. for 1 Crown; about one Month after *B* redraws upon *A* for the said Number at 2*s.* 3*d.* per Crown, and charges 1½ per Cent. for Provision; what sterling Money will discharge *A*'s Debt; also which of the Two is Gainer, and how much? *Answ.* 22*l.* 16*s.* 9*d.* discharges the Debt, and *A* gains 2*l.* 3*s.* 3*d.*

4. Suppose *London* remits a certain Sum to *Amsterdam*, at 35*s.* *Flemish* for 1*l.* sterling, with Orders to have the same remitted from thence to *Paris* at 36 Stivers for 1 *French* Crown, allowing a Provision of 10 Stivers per Pound sterling: Whether doth *London* gain or lose by this, when Remittance might have been made directly to *Paris* at 3*s.* 8*d.* sterl. per *French* Crown? *Answ.* *London* loses ¼*d.* per Crown.

Hence, though it may seem more profitable at first Sight to remit from one Place to another, and from this other to a Third, *&c.* to the Place desired; yet, when Provision, *&c.* is allowed as above, a direct Remittance may be found most advantageous.

135. *When the Course of Exchange is given betwixt one Country and another, betwixt this Other and a Third, betwixt this Third and a Fourth, &c. to find the Course betwixt any two of these Places: Or, when several different Monies are compared to find how many of one Kind are equal to some given Number of another,* Put that given Number, or Species which is of the same Name with that sought, for the Middle Term of a Question in the Rule of Three, its Equal in the first Place, and that of the same Name with its Equal in the third Place; then the Equal of this in the third Place under that in the first Place, and that of the same Name (when any) with this placed last under the third Term, continuing to place the Term which is equal the Term in each third Place, under the first Place, and the Term of the same Name (when any) with each first Place, opposite to it in the third Place: Then the continual Product of the Terms in the third Place into the

Middle Term, divided by the continual Product of the other Terms, gives the Course between the two Places, or the Term sought.

EXAMPLES.

1. *London* remits 500*l.* to *Spain* by Way of *Holland*, at 35*s. Flemish* for one Pound Sterling; from *Holland* to *France*, at 58 Grotes per Crown; from *France* to *Venice*, at 100 Crowns for 60 Ducats Banco; and from *Venice* to *Spain*, at 1 Ducat for 360 Maravedies; how many Piastres of 272 Maravedies will it amount to in Spain, exclusive of the Charges?

We shall, in the Solution of this Question, shew the Reason of our foregoing Rule; (which, we believe, is easier than any hitherto given for solving these Examples) in order to do which, put $w$, $x$, $y$, and $z$, for the respective Values in Piastres, of 360 *Maravedies*, 60 *Ducats*, 1 *Crown*, and 420*d. Flemish*.

Then 272 Maravedies : 1 Piastre :: 360 Maraved : $w$
1 Ducat : $w$ :: 60 Ducats : $x$
100 Crowns : $x$ :: 1 Crown : $y$
58 Grotes : $y$ :: 420 Grotes : $z$
1 *l.* Sterling, : $z$ :: 500 *l.* Sterl. : the Piastres.

Hence 272 Maravedies $\times w = 360$ Maravedies $\times$ 1 Piastre
1 Ducat $\times x = 60$ Ducats $\times w$
100 Crowns $\times y = 1$ Crown $\times x$
58 Grotes $\times z = 420$ Grotes $\times y$
1 *l.* St. $\times$ the Piast. $= 500$ *l.* Sterl. $\times z$

But if equal Things be multiplied by equal Things, the Products will be Equal: Therefore, by multiplying together the Numbers which constitute each Column, and by cancelling their like Letters, we have

$$\frac{1 \times 360 \times 60 \times 1 \times 420 \times 500}{272 \times 1 \times 100 \times 58 \times 1} = 2875\tfrac{1}{2} \text{ Piastres nearly,}$$

Which proves this Rule, and so may the Rule of Five be proved.

2. A Merchant of *Amsterdam* owing 800*l. Flemish* to *London*, remits the same first to *France*, at 56*d. Flem.* per Crown; from thence he orders it to be remitted to *Venice*, at 100 Crowns for 60 Ducats; from thence to *Hamburgh*, at 100*d. Flemish* per Ducat; from thence to *Lisbon*, at 50*d.* per Crusade, of 400 Rees; and lastly, from *Lisbon* to *England*, at 5*s.* 4*d.* per 1000 Rees or Mil-Rea; how much will this amount

to

to in sterling Money, and how much will be saved, supposing the Exchange from *Holland* at the same Time directly to *England*, at 36*s.* 10*d*? *Answ.* It amounts, after going to the aforesaid Places, to 438*l.* 17*s.* $1\frac{1}{2}$*d.* and there is saved by not remitting directly to *England*, 4*l.* 9*s.* 4*d* $\frac{670}{1547}$ Sterling Money.

3. A *London* Merchant having Occasion to remit a Sum of Money to *Paris*, may do the same two Ways. *viz.* He may remit by Way of *Amsterdam*, at 35*s. Flemish* per Pound sterling, and from *Amsterdam* to *Paris* at 36 Stivers per *French* Crown: Or he may remit directly to *Paris*, at 3*s.* 4*d.* Sterl. for 1 *French* Crown; which is the most advantageous Way for the Merchant? *Answ.* by Way of *Amsterdam*, by which Way he gains $1\frac{1}{7}$*d.* sterling per Crown.

## QUESTIONS

*Concerning what is called by some the* Arbitration *of* Exchange.

1. Suppose Bills at *Paris*, on *London*, to be at 32*d.* sterl. per Crown, and on *Amsterdam* at 56*d. Flemish* per Crown, how ought the Price of Exchange to go between *London* and *Amsterdam*, to be at Par with the Exchange from *Paris* to these Places? *Answ.* at 35*s. Flemish* per Pound sterling.

2. Suppose Bills at *London*, on *Amsterdam*, are at 35*s. Fl.* per Pound sterling, and on *Paris* at 32*d.* per Crown, how ought the Price of Exchange to go between *Amsterdam* and *Paris*, to be on a Par with *London* to these Places? *Answ.* at 56*d. Flemish* per Crown.

3. If Bills at *Amsterdam*, on *Paris*, run at 56*d.* per Crown, and on *London* at 35*s.* per Pound sterling, how ought the Price of Exchange to go between *Paris* and *London*, to be on a Par with *Amsterdam* to these Places? *Answer*, at 32*d.* per Crown.

4. Suppose *London* be ordered to remit to *France*, at 48*d.* per Crown, and to draw for the Value upon *Amsterdam*, at 35*s.* per Pound sterling; but when the Order came, Bills on *Paris* were at 54*s.* at what Rate must the Exchange to *Amsterdam* be made to make up for the Advance on the Remittance aforesaid? *Answ.* at 31*s. Flemish* per Pound sterl.*



* In these Examples we ought to consider, that if the Exchange is against *England* from *France*, it may not from *Holland*; and therefore to make up my Loss for this Advance, I may draw on *Holland*, as per Order,

5. Suppose in the last Example that the Course from *Paris* to *London*, when the Order arrives, is 31. 6*d.* at what Rate must *London* draw on *Amsterdam* to make the Remittance and Draught on an Equality? *Answ.* at 40*s. Flemish* per Pound sterling.

6. If *England* be ordered to remit to *Venice* at 50*d.* per Ducat, and to draw for the Value on *Spain* at 40*d.* per Piastre; but when the Order arrives, Bills on *Venice* were at 54*d.* at what Rate must *England* draw on *Spain* to make the Draught and Remittance on an Equality? *Answ.* at $43\frac{3}{27}d.$

7. *A* of *Amsterdam* gives *B* of *Paris* Orders to remit to *C* of *London* at 32*d.* per Crown, and to draw for the Value on him at 56*d. Flemish* per Crown; now if on Receipt of the said Order *B* finds the Exchange on *London* at $32\frac{1}{2}$, and upon *Amsterdam* at $56\frac{1}{4}d.$ per Crown; I demand at these Prices whether the Order would be performed to *A*'s Advantage? *Answ.* It could be performed to *A*'s Advantage 1*d. Flemish* upon every 8 Crowns.

## COMPOUND INTEREST.

136. SO called, because their being so many different Principals as there are Times of Payment; every succeeding Principal is a Compound made of the last Principal and its Interest: 'Tis also called Interest upon Interest, because Interest is paid for the Interest as well as for the Principal.*

137. *The*

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der, for the Sum remitted to *France* in Sterling Money. But if I consider the present Value of Sterling Money with respect to *France*, and act strictly according to Justice with my Correspondent, I should draw by Way of *Holland* for no more than the Value of the same No. of *French* Crowns, as I should have received by drawing directly on *France*.

* The Disputes about Compound Interest have been many: Some will have it that the Simple Interest for Parts of a Time must be taken; for say they, If I can call in and lend out again any Amount for Part of a Time, and thereby get its Simple Interest for the said Part of Time, why should I not receive in the same Part of a Time the like Premium for the same Amount or Sum lent at Compound Interest? Others suppose the Principal to gain so much Interest every Day, and that Interest to become Part of the Principal, and bear Interest the next Day, and so on: But, say these, the Principals for the *first Parts* of a Time are not so much as the Principals for the *last*: Therefore there ought not to be so much

937. *The Principal, Time, and Rate, given to find the Amount:* Find the Amount of the Principal given for the first Time of Payment, and consider this Amount as the Principal for the second Payment: which Amount calculate in like Manner, and so proceed with every Payment, accounting the last Amount the Principal of the next Payment.

*Note*, In every Operation by the above Rule the Proportion will be as 100: the Amount of 100 for a Time:: the Principal of every Payment: its Amount for said Time: Suppose the Principal 1*l.*

Then { 100 : 105 :: 1 : 1.05 the Amount of 1*l.* at 5 per Cent.
{ 100 : 106 :: 1 : 1.06 the Amount of 1*l.* at 6 per Cent.

Therefore it will be as 1*l.* : its Amount for any given Time :: any given Principal : its Amount for same Time. So that the Amount of 1*l.* at the given Rate may be made a Multiplier to the Principal of every Payment. Or the Amount of 1*l.* for the first Time of Payment may be multiplied into itself as often as the No. of Payments are, wanting one for a Multiplier to the given Principal.

EXAMPLES.

1. How much will 476*l.* amount to in 5 Years, at 5 per Cent. per Annum, Compound Interest? *Answ.* 607*l.* 20*s.* 2*d.* 2.622887.

2. "What will 50*l.* supposing the Interest payable Half-Yearly, amount to in 5 Years, or 10 Half Years, at 5 per Cent. per Annum, Compound Interest?" *Answ.* 63*l.* 16*s.* 2¾*d.*

3. How much will 700*l.* amount to in 5 Years, if the Interest is payable at 3 per Ct. for a Quarter of a Year, Compound Interest? *Answ.* 1264*l.* 5*s.* 6*d.* 2*q.* &c.

4. Suppose in the last Example that the Interest had been by Agreement to be paid Yearly at 12 per Cent. per Annum, what the Amount at Compound Interest? *Answ.* 1202*l.* 7*s.* 2*d.* &c.

5. What will 365*l.* forborn 7 Years, and 400*l.* or 300*l.* forborn 5 Years, amount to at 5 per Cent. per Ann. Compound Interest? *Answ.* to the first, 465.842784*l.* to the second, 510.54264*l.* to the third, 382.88488*l.*



much Interest allowed for the first Parts of Time as for the last. The Advocates for each Side of the Question are right; therefore our Opinion must be wrong. However, if the first is best for the Lender, the last must be most reasonable for the Borrower.

## EQUATION of PAYMENTS

138. IS when several Sums of Money are due to or by a Person, which are to be paid at different Times, and 'tis required to find a Time when the Whole may be paid without Loss to Debtor or Creditor.

139. *The common Rule is*, Multiply each Sum of Money into the Time at which it is due, and divide the Sum of the Products by the whole Debt, for the * equated Time required.

### EXAMPLES.

1. *A* owes *B* 100*l.* due at 1 Year's End, and 100*l.* due at 3 Years End, at what Time may *A* pay *B* the Whole without Loss to either? *Answ.* at 2 Years End.

2. There is a Debt of 1000*l.* to be paid; 600*l.* at 3 Mon. 200*l.* at 6 Months, and 200*l.* at 12 Months; but if it be paid at one Payment, when is the equated Time? *Answ.* at 5⅔ Months End.

3. A Debt is to be discharged by paying ½ Present, ¼ at 3 Months, and the rest at 6 Months, what is the equated Time for the Whole? *Answ.* 2¼ Months.

4. A Debt is to be paid, ½ in 2 Months, ¼ in 3 Months, and the rest in 6 Months, when is the equated Time for the Whole? *Answ.* 3¼ Months.

## ALLEGATION.

140. BY ALLEGATION we resolve Questions relating to the Mixing of divers Simples: It is either *Medial* or *Alternate*.

141. ALLEGATION

* To have a just Idea of this Rule, it must be noted, if the Times are not truly equated, the Gains of a Payer, when any thereby, arises from the Interest of the Debts, for the Time they are kept in his Hand after due: And the Loss of a Payer, when any thereby, arises from the Discount of Debts, for the Time they are paid before due: But if the equated Time is truly found, such Gains or Losses cannot arise; Now this true equated Time will not exactly be found by the above Rule, and therefore Mr. DONN, in his Arithmetic, Page 354, gives and demonstrates a Rule whereby the true equated Time may be found: But as Operations by this Rule are troublesome, and there can be no great Error in using the above for Practice, we therefore omit giving any other, and refer the more curious to peruse Mr. DONN.

## 1. ALLEGATION MEDIAL

141. Is when the Quantities and the Prices of the several Simples to be mixed are given to find the Price of some Part of the Mixture.

*The Rule for solving this Case is,* As the Sum of Quantities : the Sum of their Rates :: any Part of the Mixture : its Rate.

EXAMPLES.

1. A Tobacconist would mix 20*lb.* of Tobacco, at 9*d.* per Pound, with 60*lb.* at 12*d.*, with 40*lb.* at 18*d.*, and with 12*lb.* at 2*s.* per *lb.* what is the Mixture worth per *lb?* *Answ.* $14\frac{1}{2}d.$

2. A Vintner mixes 36 Gallons of Brandy, at 8*s.* per Gallon, 2 Gallons at 7*s.* per Gallon, 13 Gallons of Cyder, at 1*s.* per Gallon, with 12 Gallons of Water, what is the Value of 1 Gallon of this Mixture. *Answ.* 5*s.*

## 2. ALLEGATION ALTERNATE

142. Is when several Things of different Prices are to be mixed together, and it is requised to find what Quantity may be taken of each Sort, so as the Mixture may be sold at a given Rate.

143. 1. *When the Rate of several Simples to be mixt, and the Rate of the Mixture are given to find the Quantities necessary to compose it,* Link the Extremes together, and take the Difference between each No. and the mean Rate propounded, and place that Difference against its Yoke-fellow, which will be the Quantity required of that Yoke-fellow in this Mixture.

EXAMPLES.

A Merchant hath Goods at 9*d.* at 12*d.* at 24*d.* and at 30*d.* per Pound, how much of each Sort must he take, that he may sell one Pound for 20*d?*

9 ⌉ 10
12 ⌋ 4 *Answ.* He must take 10*lb.* at 9*d.* 4*lb.* at 12*d.* 8*lb.*
24 ⌉ 8 at 2*s.* and 11*lb.* at 2*s.* 6*d.*
30 ⌋ 11

2. A Merchant hath Goods at 3*s.* 6*d.* at 2*s.* 4*d.* at 4*s.* 3*d.* and at 1*s.* 4*d.* per Pound, how much of each Sort must he take to make the Mixture worth 2*s.* 8*d.* per Pound? *Answ.* he may take 2*lb.* at 3*s.* 6*d.* 2*lb.* at 2*s.* 4*d.* 14*lb.* at 4*s.* 3*d.* and 21*lb.* at 1*s.* 4*d.*

*Note,* That as many different Ways as the Numbers can be linked together, so many different Answers will be found, and yet all true: The Reason of which, and of the alternate placing of the Differences, will plainly appear, by considering, that whatsoever is lost by selling any Quantity, which exceeds the mean Price, is gained again on the Quantity allegated thereto, which is less than the mean Price.

144.

144. 2. *When the Price of all the Simples, and the Quantity of One is given to find the Quantity of all the reſt, ſo as one Quantity may bear a mean Rate or Price propoſed,* The Rule will be, As the Difference oppoſite the known Quantity: that Quantity :: any other Difference: the Quantity of its oppoſite Name.

*Note,* This Caſe is by ſome called *Alligation Partial.*

EXAMPLES.

1. A Merchant hath 30*lb.* of Goods, at 24*d.* per Pound, which he would mix with ſome at 12*d.* per Pound, ſome at 9*d.* and ſome at 7*d.* per Pound, and he would know how much of each Sort of the ſaid leſs Prices muſt be mixt with the 30*lb.* of the beſt, that he may ſell it at 16*d.* per Pound?

| | | | | |
|---|---|---|---|---|
| 30 | 12 | 8 | 8 | |
| | 24 | 4,7,9 | 20 : 30 :: 8 : 12 | the Quantity required |
| | 9 | 8 | 8 | at 12*d.* per *lb.* and becauſe the o- |
| | 7 | 8 | 8 | ther Differences are equal, it will require 12*lb.* of each. |

2. How much Malaga, at 7*s.* 6*d.* per Gallon, Sherry at 5*s.* and White Wine at 4*s.* 3*d.* muſt be mixed with 98 Gallons of Canary, at 6*s.* 9*d.* per Gallon, that the Mixture may be worth 6*s.* per Gallon? *Anſw.* There may be taken 32½ Gallons of Malaga, 13½ Gal. of Sherry, and 27 Gallons of White Wine.

145. 3. *Given the ſeveral Rates, the total Quantity and mean Rate of the Mixture to find the Quantities ſeverally.* The Rule is,— As the total Sum of the Differences: the Quantity given :: any particular Difference: its particular Quantity ſought.

*Note,* This is called by ſome *Alligation Total.*

EXAMPLES.

1. A Man hath Goods at 4*d.* at 6*d.* at 9*d.* and at 12*d.* per Pound, he would make a Compoſition of 240*lb.* worth 8*d.* per Pound, how much of each Sort muſt he take?

| | | | |
|---|---|---|---|
| 4 | 3 | then as 10 : 240 :: 3 : 72 | the Quantity at 4*d.* per *lb.* |
| 6 | 1 | 10 : 240 :: 1 : 24 | - - - - 6*d.* |
| 9 | 2 | 10 : 240 :: 2 : 48 | - - - - 9*d.* |
| 12 | 4 | 10 : 240 :: 4 : 96 | - - - - 12*d.* |
| | 10 | | |

2. A Farmer would mix Wheat at 4*s.* 6*d.* per Buſhel with Barley at 2*s.* ſo that the whole Mixture may be 50 Buſhels, and

and worth 3*s.* per Bushel, I demand how much of each Sort he must take? *Answ.* 20 Bushels of Wheat, and 30 of Barley.

## *Of Arithmetical Proportion, continued.*

146. IF in any Series of Numbers in Arithmetical Progression the Number of Terms be odd, the Double of the mean Term will be equal to any two Terms equidistant from the Mean; and if the Number of Terms be equal, the Sum of two Means will be equal to any two Terms equidistant from those Means, as will plainly appear from this Series, *viz.* 5. 9. 13. 17, &c. $=5, 5+4, 5+4+4, 5+4+4+4$, &c. from whence it is evident, by Inspection, that 4 is repeated so many Times in any Term as the No. of Terms from the Least: Hence the Reason of the two following Articles.

147. *Either of the two Extremes, the Number of Terms and common Difference being given to find the other Extreme,* Multiply the common Difference into the Number of Terms less by 1, and add to, or subtract from, the Product, the given Extreme, the Sum or Difference gives the Term required, according as it is to be greater or less than the given One.

EXAMPLES:

1. What is the 9th Term of the ascending or descending Series, which hath its common Difference $d$ and first Term $a$? *Answ.* $a+d\times n-1$.

2. What is the 9th Term (or greatest Extreme) of the ascending Series, which hath its first Term (or least Extreme) 3, and common Difference 2? *Answ.* 19.

3. What is the 9th Term of the descending Series, which hath its first Term 19, and common Excess 2? *Answ.* 3.

4. A Man hath 12 Children, the youngest whereof is two Years old, and the common Difference of their Ages is three Years, what is the Age of the oldest? *Answ.* 35.

148. *The two Extremes and the No. of Terms being given to find the Sum of the Series,* Multiply the Sum of the two Extremes into the No. of Terms, and divide the Product by 2. that is, $\frac{a+g}{2}\times n=s$ where $a$ and $g$ represent the Extremes, and $s$ the Sum of the Series.

EXAMPLES.

EXAMPLES.

1. How many Strokes doth the Hammer of a Clock strike in 12 Hours? *Answ.* 78.

2. How many Strokes do the Clocks of *Venice* (which go on to 24 o'Clock) strike in one natural Day? *Answ.* 300 Strokes.

3. Suppose 150 Eggs were placed in a right Line, each $1\frac{1}{2}$ Yard from the other, and the first $1\frac{1}{2}$ Yard from a Basket, how far will the Man go who puts those Eggs one by one into the Basket, never lifting a second Egg till he hath put every first, from the Basket, into the Basket? *Answ.* 12 Miles, 7 Furlongs, and 65 Yards.

## *Of Geometrical Proportion, continued.*

149. IF in any Series of Numbers in Geometric Progression the Number of Terms be odds the mean Term squared, will be equal to the Product of any two Terms, equidistant from the Mean; and if the No. of Terms be even the Product of any two Means, will be equal to the Product of any two Terms equidistant from those Means, as is evident from this Series, *viz.* 4, 8, 16, 32, &c. $=4, \overline{4\times2}, \overline{4\times2\times2}, \overline{4\times2\times2\times2}$, &c. from which 'tis plain, that any Term is equal to the first Term into that Power of the Ratio, which is denoted by its Distance from the first Term: Whence if over the Terms of the Geometrical Progression we put an Arithmetical One, which hath for its first Term 0, and common Difference 1, thus,

$$\underset{4}{0}, \quad \underset{4\times2}{1}, \quad \underset{4\times2\times2}{2}, \quad \underset{4\times2\times2\times2}{3}, \quad \text{&c.}$$

this last Series, called Indices, will denote the Power of the Ratio in any of the corresponding Terms of the first Series: And as any two Indices, added to, or subtracted from, each other, give an Index equal their Sum or Difference; so the Powers of the Ratio under those Indices, multiplied into, or divided by, one another, give a Power of the Ratio, denoted by the said Sum or Difference: Hence

150. *Either Extremes, the No. of Terms, and the common Ratio being given to find the other Extreme,* Raise the Ratio to a Power which hath its Index the No. of Terms less 1, and multiply, or divide, the given Extreme by that Power, the Product,

Product, or Quotient, is the required Term, according as it is to be greater or less than the given One.

EXAMPLES.

1. What is the 9th Term of an ascending or descending Series, which hath its Ratio $r$, and first or given Term $a$?

*Answ.* $a \overline{r}^{n-1}$ or $\frac{a}{r^n}$

2. The Number of Terms are 7, the common Ratio 2, and the least Extreme 3, what is the greatest Extreme? *Ans.* 192.

3. The Number of Terms are 7, the common Ratio 2, and the greatest Extreme 192, what is the least Extreme? *Answ.* 3.

151. In any Series, as 4, 8, 16, 32, &c. $=4$, $4\times2$, $4\times2\times2$, $4\times2\times2\times2$, &c. $=4$, $4\times2$, $4\times4$, $4\times8$, &c. or 5, 20, 80, 320, &c. $=5$, $5\times4$, $5\times4\times4$, $5\times4\times4\times4$, &c. $=5$, $5\times4$, $5\times16$, $5\times64$, &c. tis manifest, by Inspection, (if we put $a$ for the first Term, $r$ the Ratio, $n$ the No. of Terms, and $g$ the greatest Term) that whatever the Ratio ($r$) be, every last Term $a\times r^{n-1}$, will be $r-1$ Times greater, and 1 over, than the rest taken together: Therefore, $\frac{r^n-1}{r-1}\times a = \frac{r^n-1}{r-1}\times\frac{g}{r^n-1}$ = the Sum of the Series: Hence the Reason shewn, by Figures only, of the following Article.

152. *To find the Sum of the Series, having given their Extremes, (or the first Term and Number of Terms) and the Ratio,* Multiply the last Term into the Ratio, and from the Product take the first Term, divide the Remainder by the Ratio less 1; the Quotient is the Sum of the Series.

EXAMPLES.

1. The Extremes are 3 and 192, and the common Ratio 2, what is the Sum of the Series? *Answ.* 381.

2. A Man bought a Horse, and gave one Farthing for the first Nail in the Shoes of his Feet, 2 for the second, 4 for the third, and so on in Geometrical Proportion: The Number of Nails were 32, from whence it is required to determine what the Horse cost? *Answ.* 4473924*l.* 5*s.* 3*d.*

3. On New-Year's Day a Gentleman married and received of his Father in law one Guinea, with the Promise of a Present

sent on the first Day of every Month, for the first Year, which should be every succeeding Month double the preceding one, what was the Lady's Portion? *Answ.* 4299*l.* 15*s.*

## POSITION

153. IS a Rule wherein any false or suppositious Number is taken to work the Question by, instead of the No. required, and so by the Error or Errors found, the required No. is discovered. It is either Single or Double.

### 1. SINGLE POSITION.

154. By Single Position are solved such Questions as require only one Supposition; such as those in which the Results are proportional to their Suppositions, or which require the No. sought to be augmented or diminished by any Part or Parts of itself, or to be multiplied or divided by any No. &c.

155. *To answer Questions in this Rule:* Take any Number at Pleasure, and work with it according to your Question; and if the Result agrees with the Condition of the Question, the No. supposed is the Answer; but if not, say,

As the Result of the Supposition: the No. supposed:: that No. in the Question to which the Result of the Supposition should have been equal: the *Answer.*

*Note,* The No. 1 is generally the best Supposition.

EXAMPLES.

1. What No. is that to which if you add its ½ and ¼ the Sum will be 99? *Answ.* 36.

2. Three Men discoursing of their Ages, says the first, I am such an Age, says the second, I am twice that Age, and says the third, I am as old as the first, and one-third as old as the second; the Sum of their Ages is 208; what is the Age of each? *Answ.* 32, 42, and 96, respectively.

3. Miss *Polly* having demanded my Age, to avoid giving a direct Answer, I said ⅔ of double my Age by ¾, and ⅓ of treble my Age by ⅔, is 52; from which Miss determine my Age?

4. Three Men, *A*, *B*, and *C*, buy a Ship for 500*l.* 10*s.* of which *A* paid an unknown Sum, *B* 2 ⅓ so much, and *C* 3 ½ as much; how much did each pay? *Answ. A* 95·4756*l.* *B* 313·689*l.* and *C* 151·5853*l.*

5. What

5. What is that No. which if multiplied by 4, and the Product added to the Quotient of the ſame No. multiplied by 56, and divided by 7, the Sum will be equal to 144? *Anſw.* 12.

## 2. DOUBLE POSITION.

156. In Double Poſition two Suppoſitions are uſed. Queſtions belonging to this Rule are thoſe in which the Reſults are not proportional to their Suppoſitions; or are ſuch as require the No. ſought to be augmented or diminiſhed by ſome given Number, which is no known Part of the Number required, &c.

157. *To work Queſtions in this Rule:* Having taken any convenient Numbers for your Poſitions, work with both according to the Nature of the Queſtion, and if either of theſe anſwer the Queſtion, the Work is done; but if not, compare the Conditions of the Queſtion with the Reſult 3 of the Suppoſitions, and find whether each was taken greater or leſs than it ſhould; and if the falſe Reſult is too great, mark the Error with the Sign +; if too little with the Sign — then

Multiply each Poſition by the Error of the other Poſition, and if the Errors be of the ſame Affection, (that is, both +, or both —) divide the Difference of the Products by the Difference of the Errors: but if the Errors be of different Affections, (that is, one +, the other—) divide the Sum of the Products by the Sum of the Errors, the Quotient, in either Caſe, is the Anſwer.

Or thus: Having found the Errors,

As the Sum of the Errors, if unlike, or Difference, if alike, : the Difference of the Poſitions : : either Error : a fourth No. which added to, or taken from, its Poſition, according as the Poſition, was too little, or too much, gives the No. ſought.

*Note*, 0 and 1 are ſometimes the beſt Suppoſitions.

### EXAMPLES.

1. A certain Captain ſends out $\frac{1}{4}$ of his Soldiers + 10, and there remain $\frac{1}{3}$ + 15, how many Soldiers had he? *Anſ.* 150.

2. What No. is that which if you add $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ of itſelf, and take away 5000, the Remainder will be 100000? *Anſw.* 360000.

3. One having a certain No. of Eggs left, (without breaking any) half that No. and half an Egg at one Place, half the Remainder, and half an Egg at a ſecond Place, half this Remainder,

Remainder, and half an Egg at a third Place; and then he had one Egg left; how many had he at first? *Answ.* 15.

4. *A* stealing Apples, was apprehended by *B*, and to appease his Wrath, gives him the $\frac{1}{2}$ of what he had, and receives back 10; and going further he met with *C*, and was forced to give him the Half of what he had left, and *C* returned him 4; and going still further, he met with *D*, and was forced to give him the Half of what he had remaining, and *D* gives him back 1; at length getting safe away, he finds he hath 13 left: how many had he at first? *Answ.* 60.

For the Demonstrations of the Rules in Position, we refer our Readers to Mr. Donn's Arithmetic.

## INVOLUTION

158. IS the raising of Powers from any given Root or Number.

159. Powers are Numbers arising from the Multiplication of any No. by itself, that Product by the root, and this Product by the Root again, &c. as 2, 4, 8, 16, 32, &c. are Powers where 2 is called the Root or first Power; $4=\overline{2\times2}$ is the Square or second Power, $8=\overline{2\times2\times2}$ is the Cube or third Power, $16=\overline{2\times2\times2\times2}$ is the fourth Power, &c.

*Note*, The Index or Exponent of any Power is the Number which represents the Number of Times the Root has been used in producing the Power.

160. *To find any Power of a given No.* Take the continual Product of so many of the given equal Units as there are Units in the Index of the given Power, for the Power required.

*Note*, Any two Powers multiplied together give a Power denoted by the Sum of the Indices of the Factors.

### Examples.

1. What is the second Power of 158? *Answ.* 24969.
2. What is the 3d Power of 94·5? *Answ.* 843908·625.
3. What is the 6th Power of 12? *Answ.* 2985984.
4. What is the Square of $\frac{2}{3}$? *Answ.* $\frac{4}{9}$.

A TABLE

der, bring down Cyphers two at a Time, and carry the Root into Decimals at Pleasure.

*Note*, When the Root of a Surd No. is approximated to 1 more than Half the Number of Places intended, the Rest may be obtained, by dividing the last Remainder by its corresponding Divisor, annexing a Cypher to every Remainder, as in Division of Decimals; or rather, by proceeding with the Divisor and Remainder, as directed in Article 64.

**What is the Square Root of 10, when approximated to 14 Decimal Places?**

10(3.16227766016837=the Answer.
9

61) 100
61

626)3900
3756

6322)14400
12644

63242)175600
126484

632447)4911600
4427129

6324547)48447100
44271829

63245546)4175271 00
379473276

63245526)3805382400
3794733156

10649244

63245526)01649244(016837
4324689

529956
23992
5019
582

Proceed here as directed in the last Note.

164. *When a Vulgar Fraction is given to have its Square or any other Root extracted*, Take the Root of the Numerator, and of the Denominator, and place over one another: But if each Term of the Fraction cannot be extracted without a Remainder, the Fraction may be made a Decimal one, the Root whereof

whereof may be extracted like a whole No. Reduce whole Numbers also to Decimals.

EXAMPLES.

1. What is the Square Root of 608400? *Answ.* 780.
2. What is the Root of 669124? *Answ.* 818.
3. What is the Root of .001234? *Answ.* .035128336$\frac{2}{3}$.
4. What is the Root of 2? *Answ.* 1.414213527 nearly.
5. What is the Root of $\frac{4768}{117225}$? *Answ.* $\frac{36}{\sqrt{15}}$.
6. What is the Root of $\frac{2}{3}$? *Answ.* .8164.
7. What is the Root of $\frac{4}{9}$? *Answ.* $\frac{2}{3}$.
8. What is the Square Root of 300? *Answ.* 17.3205+
9. What is the Root of 192? *Answ.* 13.8564+
10. What is the Root of $\frac{8}{15}$? *Answ.* .86609+

165. *To extract the cube Root of any given No.*

1. Having pointed the given Resolvend as before directed, seek the greatest Cube in the Left-hand Period, write the Rest in the Quotient, and subtract the Cube of the said Root from that Period.

2. To the Root, annex so many Cyphers as there are remaining Periods, and multiply this by 3; then make this Product a Divisor, by which you must divide the Difference between the Resolvend and the aforesaid Cube; point the Quotient into Periods of two Places, (beginning at the Units Place) observing that there be no more Points than there were Periods brought down to the Resolvend.

3. Make the Root, found in the first Period of the given No. a Divisor, and see how often it may be had in the Left-hand Period of the Quotient, (excepting the Place under the Point) and the Figure resulting write in the Quotient, on the Right Hand of the Root first found, and on the Right Hand of the Divisor; multiply this increased Divisor, by the last Quotient Figure, and to the Remainder bring down the next Period, and proceed the same.

EXAMPLES.

EXAMPLES.

Extract the Cube Root of

```
                    .   .   .   .   .
                 8302348000000(2
                 8                (+0244
              ------------------------------
2000 × 3 = 6|000)302348000|000(20244
                    .   .   .   .
                 202)5039133(0244
                     404
                 ------------
                2024)9991
                     8096
                 ------------
               20244) 89533
                      80976
                 ------------
```

But 20244 is not the true Root of the given Power, as may be found by involving it: Therefore I take 4 Figures of the increased Root, and proceed to a second Operation, which will discover the Root true to 12 Places of Decimals; if these 4 are true, because every Operation finds the Root true to 3 Times the Number of Figures the preceding one does.

```
                .   .   .   .   .   .
             8302348000000(20240 × 3 = 60720 Divisor.
             8291469824
             ------------
60720)  10878176 00(179153.42556
                .   .   .   .   .
20248) 179153.425560(8.8479+
       161984
       ------
202488) 1716942          20240
        1619904              8.8479+
        -------          ---------
2024884)  9703855        20248.8479+ the Root nearly true, tho' the Places in the Root might have been continued to 12 Places.
          8099536
          -------
            &c.
```

Cubes.

| Cubes. | Roots. | Cubes. | Roots. |
|---|---|---|---|
| 7121.102 | 19.238 | $1\frac{1}{2}$=1.33 | 1.1606 |
| 7612.812 | 19.67+ | 2150.42 | 12.9081 |
| 282 | 6.558 | 231 | 6.136 |
| .12181281 | .495+ | 61218.00121 | 39.41+ |

## *A* General Rule *for the Extraction of all Roots of Integers and Decimals.*

166. FIND what No. with Cyphers annexed, which if involved to the Height of the given Power, will be the neareſt to the Root of the given No. And as a Help towards finding this No. remember, that when the next leſs Power is but little nearer than the next greater, the Root of the next leſs may not be the neareſt; therefore annex 5 to the Root of the next leſs Power, and raiſe the Reſult to the Height of the given Power, and you will find thereby whether it is the neareſt Root of the given No. or not.

2. Take the Difference between this Power and the firſt Period, and annex a Cypher to it for a Dividend.

3. Involve the Root laſt found into the next inferior Power to that which is given, and multiply this by the Index of the given Power for your Diviſor.

4. Perform Diviſion, and annex their Quotient to the Root, if the firſt Figure was leſs than the Root; but if it was greater, annex a Cypher to the Root, and take the ſaid Quotient Figure from it; the Remainder conſider as the two firſt Figures of the Root.

5. Involve the Part of the Root thus found into the given Power.

6. Take its Power at every Repetition of the above Directions from as many of the firſt Periods of the given Power as you have placed Figures in the Root for a Dividend as before.

7. Find a Diviſor as before.

8. Perform Diviſion, and add to, or take from, the Figures of the Root, with a Cypher annexed the Quotient, according as the ſaid Figures were taken more or leſs than juſt; and conſider

consider the Result as the three first Figures of the Root.

7. With these 3 find the rest of the Root in the same Manner.

*Note* 1. In the Extraction of Roots, observe what Numbers multiplied together produce the Index of the required Root, and make such Extractions as are denominated by these Numbers. Thus for the fourth Root, extract the Square Root of the given Number, and then the Square Root of that Root. For the 6th Root, extract the Square Root of the given Number, and then the Cube Root of that Root, For the 8th Root, extract the Square Root of the given No. then the Square Root of that Root, and then the Square Root of the last Root. For the 9th Power, extract the Cube Root of the given No. and then the Cube Root of that Root, and so on.

2. In extracting the Roots of the 4th and 8th, &c. Powers, when the given Number is a Surd, you must continue the Extraction till you have twice so many Decimal Places in the first Root, as you intend to have in the second, &c.

EXAMPLES.

1. What is the 3d Root of 2?
2. What is the 4th Root of 4857532416? *Answ* .264.
3. What is the 5th Root of 12309502009375? *Ans.* 415.
4. What is the 7th Root of 37323655395507812 5? *Ans.* 325.

## *Of* INFINITE DECIMALS.

167. AN *Infinite Decimal* is one which ariseth from a Vulgar Fraction, which, with its Numerator and Cyphers annexed, is not a Multiple of its Denominator.

168. In Infinite Decimals if a Figure continually repetes or circulates, it is called a *single Repetend*; and to distinguish it from others which do not repete, called the *finite Part*; the Repetend is marked with a Dash: Thus ·1333, &c. is marked ·13, which signifies that the 3 is continually repeated: Also ·1333 signifies that the three Threes are continually annexed or repeated; but 3 continually repeated must be the same as three Threes continually annexed. If several Figures continually repete or circulate, they are called a *compound Repetend*, to distinguish which, the first and last repeating Digits are marked: Thus for ·181818, &c. and ·234234234, &c. we write ·$\dot{1}\dot{8}$ and ·$\dot{2}\dot{3}\dot{4}$.

169. When Decimals are partly finite, and partly infinite, they are called *mixt Decimals*.

170. There are another Kind of Decimals called *uncertain* or *approximating Decimals*, which cannot easily be determined

whether they be finite or infinite, unless fully followed out, which is very troublesome.

171. *Similar Circulates* are such which have Repetends consisting of the same Number of Places, and beginning at the same Distance from the Decimal Point.

172. A Series of Nines supposed infinitely continued are equal to an Unit or 1 in the next Left-hand Place: Thus, $\cdot 9 = 1$, and $\cdot 0\dot{9} = 1$: For 'tis evident that 9 wants only $\frac{1}{10}$ of an Unit; 99 only $\frac{1}{100}$; 999 only $\frac{1}{1000}$, &c. so that if the Series were continued to Infinity, the Difference between such Series of Nines and Unity, or an Unit, would be equal to 1 divided by Infinity, which is nothing at all. Hence

$\cdot 3 = \frac{1}{3}$ of $\cdot 9 = \frac{3}{9}$; $\cdot 6 = \frac{6}{9}$; $\cdot 0\dot{6} = \frac{6}{9}$ of $\frac{1}{10} = \frac{6}{90}$; $\cdot \dot{3}\dot{3} = \frac{1}{3}$ of $\cdot \dot{9}\dot{9} = \frac{33}{99}$; $\cdot \dot{3}\dot{7} = \frac{37}{99}$: And $\cdot 0\dot{9}\dot{9} : 1 :: \cdot 03\dot{1} : \frac{31}{990}$; also $\cdot \dot{9}\dot{9} : 1 :: 3 \cdot 1 : \frac{310}{99} :: 23 \cdot \dot{7}\dot{3} : \frac{2300}{99}$; Likewise $\cdot 9999 : 1 :: 32.18 : \frac{321800}{9999}$

So $.23 = \frac{2}{10} + \frac{3}{9}$ of $\frac{1}{10} = \frac{21}{90}$; $\cdot 23\dot{6} = \frac{2}{10} + \frac{36}{99}$ of $\frac{1}{10} = \frac{2364}{990}$;

$$243\dot{7}3 \cdot 2 = 24000 + \frac{32000}{999} = \frac{24000 \times 99 + 3200}{99} = \frac{2408000}{99}$$

Therefore,

173. *To find the finite Value of a pure Circulate.*

1. *When the repeating Part contains a certain Number of integral Places*, annex to it so many Cyphers as are integral Places for a Numerator, and for a Denominator take so many Nines as the Repetend hath Places.

2. *When the repeating Part is all Decimals*, Take the Repetend for a Numerator, and for a Denominator so many Nines as the Repetend hath Places, with so many Cyphers annexed as are Places between the Repetend and the Decimal Point.

EXAMPLES.

What is the finite Value of $\cdot 1\dot{8}$, of $\cdot 0\dot{7}$. of $\cdot \dot{4}\dot{7}$, of $3 \cdot 1\dot{8}$, of $31 \cdot 8$. &c.

174. *To find the finite Value of a mixt Circulate.*

Multiply the finite Part by as many Nines as there are Places in the Repetend, and add thereto the Repetend for the Numerator, and the Denominator will be the same as the Denominator of the circulating Part found by the last Article.

175. But it will be found more convenient to multiply the given Circulate by so many Tens as there are Figures in the Repetend, (which is done by removing the Decimal Point as directed in Art 60) for then the Product will be too much

for

for the Numerator by the Figures in the finite Part, which finite Part must therefore be taken from the aforesaid Product, for the Numerator required. [See Article 183 ]

EXAMPLES.

What is the finite Value of 57.$\dot{7}$, of 13$\dot{8}$, of .00$\dot{8}$49713, and of 746 083$\dot{7}$? *Answers* $\frac{520}{9}$, $\frac{125}{900}$, $\frac{849705}{9999900000}$, & $\frac{671475}{900}$.

176. A Circulate may be supposed be begin at any Distance from the Decimal Point: So $\dot{4}$ may be supposed to have the first or more Places finite, and the following Ones infinite: For Instance, it may stand thus, .4$\dot{4}$ $=\frac{4}{10}+\frac{4}{9}$ of $\frac{1}{10}=\frac{4}{9}$; or thus, .44$\dot{4}$ $=\frac{44}{100}+\frac{4}{9}$ of $\frac{1}{100}=\frac{4}{99}$, &c. Also the pure Circulate .$\dot{4}$28571$\dot{4}$ may be changed into an equal mixt one, which shall have in the finite Part *two*, and in the infinite Part *twelve Places*. Thus $\dot{4}$28571$\dot{4}$ $=$ 428571428571$\dot{4}$ $=\frac{42}{100}=\frac{857142857142}{999999999999}$ of $\frac{1}{100}$: But we cannot change a compound Repetend into a new one of any No. of Places which is not a Multiple of the No. of Places in the given Repetend. For Instance, we cannot change this last into one of 4 or 8 Places, because neither 8571, nor 85714285 do circulate in the same Order as the given Circulate. Hence.

177. *To make several Circulates similar*, Take the least common Multiple of the several Nos. of Places in the given Repetends, for the No. of Places that each of the new Repetends must have; remembering, that these must all begin at the same Distance from the Decimal Point, as the last Place of the longest given Finite.

EXAMPLES.

$\frac{2}{3}=.6$ $=.666666\dot{6}$
$\frac{2}{11}=.1\dot{8}$ $=.181818\dot{1}$
$\frac{1}{37}=.0\dot{2}\dot{7}$ $=.027777\dot{7}$
$\frac{1}{4}=.025$ $=.025000\dot{0}$
$\frac{1}{7}=.142857\dot{1}=.\dot{1}42857\dot{1}$

} Here the Nos. of Places in the given Repetends being 1, 2, 1, 6, the least common Multiple is 6.

ADDITION.

178. *To add infinite Decimals*, Make them similar, and divide the Sum of the Repetends by their common Denominator; put down the Remainder for the Repetend of the Sum, and carry the Quotient to the finite Part, which add as in common.*



* Some Authors direct you to, "find how many Tens there are in the Sum of the Left-Hand Column of the Repetends, which you are to carry to the Right-Hand Column as you begin to add", and then to proceed in common Addition: but that such Directions are insufficient is perceived from the second Example.

EXAMPLES.

| | Dissimilar. | Made similar. |
|---|---|---|
| 1. | $\dot{6}$ | $\cdot 666666666\dot{6} = \cdot 666 + \frac{666666}{999999}$ of $\frac{1}{1000}$. |
| | $\cdot 1\dot{8}$ | $\cdot 1818181\dot{8} = \cdot 181 + \frac{818181}{999999}$ of $\frac{1}{1000}$. |
| | $\cdot 027\dot{7}$ | $\cdot 027777777\dot{7} = \cdot 027 + \frac{777777}{999999}$ of $\frac{1}{1000}$. |
| | $\cdot 025$ | $\cdot 025000000\dot{0} = \cdot 025 +$ |
| | $\cdot 142857\dot{1}$ | $\cdot 142857142\dot{8} = \cdot 142 + \frac{857142}{999999}$ of $\frac{1}{1000}$. |
| | Sum | $1 \cdot 044119768\dot{8} = 1 \cdot 044 + \frac{119768}{999999}$ of $\frac{1}{1000}$. |

2. Add $\cdot 704\dot{3}$ and $\cdot 79\dot{3}\dot{4}$ together? *Answ.* 1·5
3. Add $3 \cdot \dot{6}$, $7 \cdot 347\dot{6}$, $24 \cdot \dot{3}$, $482 \cdot 583\dot{7}$, and $482 \cdot \dot{4}$ together?
4. Add $\cdot 41\dot{6}$, $\cdot 5\dot{1}\dot{8}$, $2 \cdot 9\dot{3}\dot{7}$, $8 \cdot 1\dot{4}$, $4 \cdot 1\dot{8}$, and $2 \cdot 8\dot{3}$ together?

## SUBTRACTION.

179. *To subtract infinite Decimals*, Make them similar, and if the Repetend in the Subtrahend be less than that in the Subtractor, add 1 to the Right-Hand Figure in the Subtractor before you begin; in other Examples proceed as usual.

EXAMPLES.

| | | | |
|---|---|---|---|
| *From* $7 \cdot 1283\dot{3}$ | or | *From* $7 \cdot 12\frac{13}{99}$ |
| *Take* $4 \cdot 8434\dot{4}$ | | *Take* $4 \cdot 84\frac{54}{99}$ |
| $2 \cdot 2778\dot{8}$ | | $2 \cdot 27\frac{78}{99}$ |

2. Take any two of the given Numbers in Addition from each other?

## MULTIPLICATION.

180. *To multiply infinite Decimals*, Find the Product of the finite Values of both Factors by Multiplication of Vulgar Fractions: *And if you require it Decimally*, Reduce the Vulgar Fraction to a Decimal One.

EXAMPLES.

1. Multiply $2 \cdot 52\frac{8}{9}$ by $47 \cdot 7\frac{8}{9}$, or $2 \cdot 52\dot{8}$ by $47 \cdot 7\dot{8}$?

$$\frac{2 \cdot 52\frac{8}{9}}{9} \quad \frac{47 \cdot 7\frac{8}{9}}{9}$$

$$\frac{2276}{900} \times \frac{4301}{90} = \frac{9763270}{900 \times 90} \text{ Answ.}$$

Before

Before we give more Examples, it may not be amiss to explain the Methods of multiplying and dividing by any Number of Nines, or any Number nearly = to 10 and its Powers, and to give Rules for the same.

181. *To multiply by any Number nearly equal to* 10 *or its Powers*, Assume 1 with so many Cyphers annexed as the given Multiplier contains Units, for a Multiplier, and the Product will be too much by the Multiplicand into the Difference between the given and assumed Multipliers.

Multiply 2825 by 999

2825000

—2825

2822175 Product.

182. On the Contrary, suppose 2822175 was to be divided by 999; I assume 1000 for a Divisor, (which is 1 more than 999) and the first Result is 2822·175; but having taken hereby 2822·175 Times 1 too many out of the Dividend, it is requisite that this should be divided again; which done, the Result will be (by 1000) 2·822175; and having in this last Division taken 2·8, &c. too many from the Dividend, I divide this again, and the Work stands as in the Margin, where the continuing of more Divisions is unnecessary. Hence the following Rule.

2822·175
2·822175
2822 &c
2824·9998

183. *To divide by any No. nearly equal to* 10 *or its Powers*, divide the Dividend by 1, with so many Cyphers annexed as the given Divisor contains Digits, and divide this and each succeeding Quotient or Result, multiplied by so many Units as the given Divisor is less than the assumed one, by the assumed Divisor; the Sum of these Results will be that sought. Otherwise with less Figures.

184. *To divide by any Number of Nines*, Divide the Dividend in Periods of so many Figures each as the Divisor contains Nines; and if you want to compleat a Period, annex Cyphers; set the first Period on the Left Hand, under the next on the Right; add these, and set their Sum under the third Period; if there be any Carriage for Tens at the End of such Addition, set it under the Units Place of the second and third Periods; proceed the same until you have placed Figures under the Right-Hand Period, under the Units Place of which

put what would have been carried, had the Work been continued.

Add the Whole together, and from the Sum cut off so many Right-Hand Figures as there are Nines in the Divisor, and Cyphers (or repeating Figues) annexed to the Dividend for the Remainder to the given Divisor, the other Places are the Quotient.

EXAMPLES.

1. Divide 282174543 by 999.

282, 174, 543
282, 456

282 456 $999 = 282457$ Quotient.

2. Divide 204081224490 by $999999 \times 999999$?

This we do by two Divisions, thus:

First Division
204081, 2.24490
2 04081

$204081, 428571 = 204081 \frac{428571}{999999} = 204081\frac{3}{7}$.

428571. The second Division will stand thus:

| 204081 | 428571 | 428571 | 428571 | 428571 | 428571 | 428571 | 428571 |
|---|---|---|---|---|---|---|---|
| | 204081 | 632652 | 061223 | 489795 | 918366 | 346937 | 775509 |
| | | 1 | 1 | | 1 | 1 | |

204081 632653 061224 489795 918367 346938 775510 204081

∴ the Quotient is $\cdot 0\dot{2}0408163265306122448979591836734693877551 = \frac{1}{49}$.

Having given and explained these Rules, we proceed to give more Examples for multiplying Decimal Expressions.

2. Multiply $\cdot 7\dot{5}\dot{8}$ by $\cdot 7\dot{9}\dot{8}$? *Answ.* $\frac{76664}{999 \times 999}$

3. Multiply $24 \cdot \dot{8}$ by $\cdot 025$? *Answ.* $.6\dot{4}$.

4. Multiply $27 \cdot \dot{7}$ by $.\dot{4}$? *Answ.* $9.\dot{8}\dot{9}$.

## DIVISION.

185. *To Divide infinite Decimals*, Reduce both Divisor and Dividend to their finite Values, and divide as in Vulgar Fractions;

tions; *and if you require the Quotient in Decimals,* reduce the Vulgar Fraction to a Decimal one.

EXAMPLES.

1. Divide 120·53418 by 2.528? *Answ.* 47·78.
2. Divide 9 89 by ·4? *Answ.* 27 1.
3. Divide 67 by ·025? *Answ.* 24·8.

## MULTIPLICATION OF DUODECIMALS,

### COMMONLY CALLED

## CROSS MULTIPLICATION.

186. IN Multiplying these Dimensions together, observe that

| | | |
|---|---|---|
| Feet into Feet | L. Meas. prod. | Feet |
| Feet into Inches, or 12ths | | 12ths of Feet |
| F. into Parts, or 12th of In. | | 144ths of Feet=Inches. |
| Inches into Inches | | Inches=144ths of Feet |
| Inches into Parts | | 12ths of Inches |
| Parts into Parts, | | 144ths of Inches |

Square Meas.

| | | | |
|---|---|---|---|
| Feet | Square Measure, into | Feet | Linear Measure produce |
| Feet | | Inches | |
| Feet | | Parts | |
| 12ths of Feet | | Feet | |
| 12ths of Feet | | Inches | |
| 12ths of Feet | | Parts | |
| Inches | | Feet | |
| Inches | | Inches | |
| Inches | | Parts | |
| 12ths of Inches | | Parts | |

| |
|---|
| Feet |
| 12ths of Feet |
| 144ths of Feet |
| 12ths of Feet |
| 144ths of Feet |
| 1728ths of Feet=Inches |
| 144ths of Feet |
| Inches=1728ths of Feet |
| 12ths of Inches |
| 144ths of Inches |

Solid Meas.

*Note,* The best Way of reading these Denominations will be to name them *Feet, Primes, Seconds, Thirds,* &c. having a due Regard to know whether they are *Linear, Superficial,* or *Solid* Feet, Primes, Seconds, Thirds, &c. and taking *particular* Notice in *Linear Measure,* that the *Primes* are *Inches*; in *Square Measure,* that the *Seconds* are *Inches*; and in *Solid Measure,* that the *Thirds* are *Inches.*

187. Tho' Multiplication of Duodecimals may be performed from the forgoing, these Products will be better found by one of the two following Methods.

I. By the Help of Aliquot Parts.

Having multiplied the Feet in the Factors together, take such Part or Parts of the Multiplicand as the Primes in the

Multiplier are of 1 Foot, and take ſuch Part or Parts of the Feet in the Multiplier as the Primes, &c. in the Multiplicand are of 1 Foot; the Sum of theſe are the Anſwer.

Or having multiplied the Feet by the Feet, you may take a Part or Parts of the Multiplicand for Part of the Primes, &c. in the Multiplier, and a Part or Parts of the Part or Parts already taken for the reſt of them; and take a Part or Parts of the Feet in the Multiplier for Part of the Primes, &c. in the Multiplicand, and a Part or Parts of thoſe already taken for the reſt; the Sum of theſe Reſults is the Anſwer.

2. *When neither Factor exceeds* 12,

Place the Feet of the Multiplier under the Seconds in the Multiplicand, then multiply the Seconds, Primes, and Feet of the Multiplicand by the Seconds, Primes, and Feet (ſeparately) of the Multiplier, placing the firſt Figure of every Product under the multiplying Number, and carrying 1 for every 12 from one Denomination to another; the Sum of theſe Products is the Product required.

EXAMPLES.

| | *F. Pr.* | *F. P.* | *F. P.* | *F. P.* |
|---|---|---|---|---|
| Multiply | 8 9 | 8 9 | 9 3 | 24 10 |
| By | 3 6 | 7 3 | 6 6 | 8 9 |
| Product | 30 7 6 | 63 5 3 | 60 1 6 | 217 5 6 |

| | *F. I.* | *F. P.* | *F. P.* | *F. P.* |
|---|---|---|---|---|
| Multiply | 7 9 | 7 10 | 10 3 | 2 6 |
| By | 7 6 | 2 3 | 3 5 | 2 6 |
| Product | 56 3 | 17 7 6 | 35 0 3 | 6 3 |

| | *F. P.* | *F. P.* | *F. P.* | *F. P.* |
|---|---|---|---|---|
| Multiply | 97 8 | 75 9 | 569 9 | 84 11 |
| By | 8 9 | 17 7 | 76 4 | 12 4 |
| Product | 854 7 | 1331 11 3 | 43490 11 | 1047 3 8 |

Multiply

| | F. P. S. | F. P. S. | F. P. S. |
|---|---|---|---|
| Multiply | 15 7 5 | 3 4 6 | 7 3 6 |
| By | 7 6 | 2 8 3 | 5 4 6 |
| Product | 9 9 1 7 6 | 9 0 10 1 6 | 36 2 3 9 |

| | F. P. S. | F. P. S. | F. P. S. |
|---|---|---|---|
| Multiply | 37 7 5 | 40 10 3 | 321 7 3 |
| By | 4 8 6 | 30 6 6 | 9 3 6 |
| Prod. | 177 1 5 0 6 | 1247 9 0 7 6 | 2988 2 10 4 6 |

| | F. P. S. | F. P. S. | F. P. S. |
|---|---|---|---|
| Multiply | 276 7 10 | 317 9 7 | 259 10 8 |
| By | 25 9 7 | 37 5 9 | 18 5 4 |
| Prod. | 6905 0 7 0 10 | 11910 9 11 1 3 | 4793 6 0 10 8 |

*Note,* Though these Kind of Questions are improperly proposed, as may be discovered by the Note, Page 36; in Compliance to the common Method, and from Consideration of the Utility of Duodecimals in Artificers Work, it may be properly passed over: However, the Learner ought to be made understand the Reason of this Kind of Multiplication, which the Master may easily shew by Fractions: He ought also, *particularly*, to be made know, that the common Method of reading these Products is absurd.

# GEOMETRICAL DEFINITIONS.

## *Of* ANGLES.

188. AN ANGLE is made by the mutual Inclination of two Lines, which meet together in a Point: And all Angles included between *right Lines*, are called *right-lined Angles*.

189. There are three Sorts of right-lined Angles.

1. When a Line stands on another, making the Angles on each Side thereof equal, then those Angles are called *Right Angles*.

2. If the Angle is greater than a Right one, it is called an *Obtuse Angle*.

3. But, if the Angle be less than a Right one, it is called an *Acute Angle.*

And all Angles that are not Right ones, are, in general Terms, called *Oblique Angles.*

## *Of* SURFACES.

190. A PLANE SURFACE, is any Figure which lies evenly between its Extremes or Bounds; and if these Extremes or Bounds are Right Lines, the Figure is called a *rectilineal* or *right-lined Plane:* But if the Extremes or Bounds of a Plane are crooked or curve lined, the Figure is called a *Curvilineal Surface* or *Plane.*

191. A TRIANGLE is a Figure of three Sides, and when these Sides are equal, it is called an *equilateral Triangle:* If only two Sides are equal, it is called an *Isosceles Triangle:* But if all the Sides are unequal, it is called a *Scalenous Triangle.* A Triangle is called a *right-angled Triangle,* if it hath one right Angle: It is called an *obtuse-angled Triangle,* when it hath one obtuse Angle: And an *acute-angled Triangle,* when all the Angles are acute. It is also called an *equiangular Triangle,* when the Angles are equal: And, in general Terms, all Triangles that have not one right Angle, are called *oblique-angled Triangles.*

*Note,* The longest Side of a right-angled Triangle is called the *Hypothenuse,* and the other Sides the *Base* and *Perpendiculars:* The longest Side of other Triangles is called the *Base,* and the other Sides the *Legs.*

192. A PARALLELOGRAM is a four-sided Figure, which hath its opposite Sides parallel, and consequently equal: When its four Angles are right ones, and the opposite Sides only, equal, it is called a *Rectangle* or *Oblong:* And when its four Angles are right ones, and the Sides all equal, it is called a *Square:* If its Angles are neither right ones, and the opposite Sides only, equal, it is called a *Rhumboides:* And if its Sides are all equal, but its Angles neither right, it is called a *Rhumbus.*

193. A TRAPEZIUM is a four-sided Figure, which hath not each Pair of opposite Sides parallel.

194. A TRAPEZOID is a Trapezium, which hath two Sides parallel.

*Note,* A Line drawn from any Angle in a four-sided Figure, to its opposite Angle, is called a *Diagonal.*

195. A REGULAR POLYGON is that which hath all its Sides and Angles equal; and is named according to the Number of its Sides, *viz.* If it hath 5 Sides it is called a *Pentagon;* if 6 a *Hexagon;* if 7 a *Heptagon;* if 8 an *Octagon,* &c.

196. An

196. An IRREGULAR POLYGON is a Figure which hath its Sides and Angles unequal.

197. A CIRCLE is contained under one uniform Curve Line called the *Circumference*, or *Periphery*, which is described about a Point called the *Center*.

198. The RADIUS of a CIRCLE is the Distance between the Center and Circumference.

199. The DIAMETER of a CIRCLE is a right Line drawn through the Center, terminating each Way at the Circumference.

200. A CHORD is a right Line drawn from one Part of any Arch of a Circle to the other.

201. A SEGMENT of a CIRCLE is a Figure included between the Chord and that Arch of the Periphery cut off by the Chord.

202. A SEMI-CIRCLE, or Half a Circle, is a Segment which hath for its Chord the Diameter.

203. A SECTOR of a CIRCLE is a Figure included between two Radiuses and that Arch of the Periphery which joins them together.

204. A QUADRANT, or Quarter of a Circle, is a Sector which hath its Radiuses meeting one another perpendicularly.

205. An ELLIPSIS is a Curve-lined Figure made by a Plane cutting a Cone through both its Sides, *not parallel*, to its Base.

*Note*, The longest of the two principal Diameters of an Ellipsis is called the *Transverse* Diameter; the shortest the *Conjugate*.

206. A PARABOLA is a Figure made by a Plane cutting a Cone parallel to one of its Sides.

## *Of* SOLIDS.

207. A SOLID is that which has three Dimensions, *viz.* *Length*, *Breadth*, and *Thickness*.

208. A PRISM is a Solid, whose two Ends are parallel Planes of any rectilineal Form whatever; the Planes of the Sides of this Solid are Parallelograms, whose Ends form the Ends of the Prism, which Ends are equal, parallel, and alike situated.

When the Parallelograms, or Sides, stand perpendicular to the Plane of the End or Base, the Figure is called an *upright Prism*; but when they stand inclined to the Base, it is called an *oblique Prism*.

Prisms have their Names from the Figure of their Bases.

If the Base be a Triangle, it is called a *Triangular Prism*;

If

if its Baſe be a Square, it is called a *Square Priſm*; if a Pentagon, a *Pentagonial Priſm*, &c.

If the Length, Breadth, and Thickneſs of a Priſm be equal, it is called a *Cube*: And,

If the Baſe be a *Rectangle*, it is called a *Parallelopipedon*.

When the Number of Parallelograms, forming the Sides of a Priſm, are infinite, it will be like a rowling Stone, and it is then called a *Cylinder*: Or,

209. A CYLINDER may be defined to be a Solid, generated by the Revolution of a retangular Parallelogram about one of its Sides.

210. A PYRAMID is a Solid which hath its Baſe a Polygon, and its Sides Plane Triangles: The Tops of theſe Triangles meet together in the Point called the Vertex of the Pyramid, and their Baſes form the Baſe of the Pyramid.

Pyramids, like Priſms, are either right or oblique, and have their Names from their Baſes: For Inſtance, a Triangular, Square, Pentagonal, Hexagonal, *&c.* Pyramid, hath for its Baſe a Triangle, Square, Pentagon, Hexagon, *&c.* If the Number of Triangles, forming the Pyramid, be ſuppoſed Infinite, it will then be called a *Cone*: Or,

211. A CONE may be defined to be a Solid, generated by the Revolution of a right-angled Triangle, about one of the Sides which contains the Right Angle.

212. A SPHERE is a Solid made by the Rotation of a Semi-Circle about the Diameter.

213. A SPHEROID is a Solid, generated by a Semi-Ellipſis, revolving about the tranſverſe, or conjugate Diameter: If the Rotation is made about the Tranſverſe, or longeſt Diameter, it is called a *prolate Spheroid*; but if about the conjugate, or ſhorteſt Diameter, it is called an *oblate Spheroid*.

214. A PARABOLIC SPINDLE is a Solid made by the Rotation of a Parabola, about its greateſt Ordinate.

215. A CONOID is a Solid produced by the Circumvolution of any Section of a Cone about its Axis.

216. A PRISMOID is a Solid which hath for its two Ends any diſſimilar Parallel, plane Figures, of the ſame Number of Sides, and all the Sides of the Solid, Plane Figures alſo.

217. A FRUSTRUM is what remains after a Part (called the Segment) is cut off next the Vertex of any tapering Solid by a Plane parallel to its Baſe.

218. An HOOF is made by a Plane cutting a Fruſtrum diagonally through the oppoſite Extremities of the two Ends.

219. A

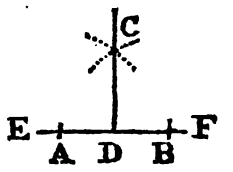
219. A ZONE of a Sphere, *&c.* is a Part intercepted between two parallel Planes.

220. A MIDDLE ZONE of a Sphere, *&c.* is that which hath its parallel Ends equally distant from the Center or Middle.

# PROBLEMS *of* GEOMETRY.

## PROBLEM I.

221. *ON any Point D; to erect a Perpendicular to a Line* E F: Take a Distance on each Side D equal as AD=D B; with the same Extent of the Compasses on A and B, make the Intersection at C, and draw C D the Perpendicular required.

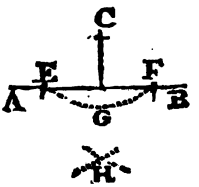



EXAMPLES.

On the Middle of a Line of 250 in Length, erect a Perpendicular of 270, or 156?

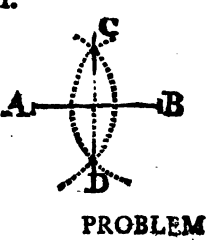
## PROBLEM II.

222. *From any Point, as at* C, *to let fal. a Perpendicular on a Line* A B: On the given Point C, strike the Arch EGF, cutting A B in E and F; on E and F, with any Extent, make the Intersection H; lay a Ruler from C to H, and draw C D the Perpendicular required.




## PROBLEM III.

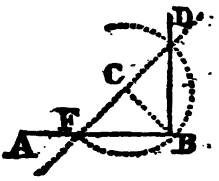
223. *To bisect a Line as* A B: With the same Extent, on the Extremities A and B, make the Intersection at D and C, thro' which draw D C, which bisects A B as required.




PROBLEM

## PROBLEM IV.

224. *To erect a Perpendicular on the End of a Line* A B: Take a Point within the given Line at random, as at C; with the Extent C B, describe a Circle; from its Intersection at F draw the Diamer F C D; and from D draw D B for the Perpendicular required.

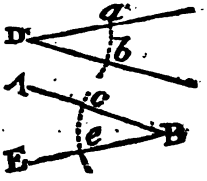



EXAMPLES.

On the Extremity of a Line 75 long, erect a Perpendicular of 82, or 34?

## PROBLEM V.

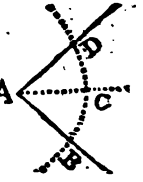
225. *At* B, *in a Line* A B, *to make an Angle equal a given one* D: On the Angular Point D, describe an Arch, as *a b*; with the same Extent on B, describe the Arch *c e*, which make equal to *a b*; and through the Points *b*, *e*, draw E B, it will make the Angle B equal to the Angle D.




## PROBLEM VI.

226. *To make any Right-lined Angle:* Draw a Line A B; with the Chord of 60° upon A, sweep the Arch E F; from the same Line Chords take the proposed Degrees and lay upon the Arch from E to F, and draw A C; then will B A C be the Angle required.

*Note*, If the proposed Angle is more than 90°, take any two Chords equal to the given One, and lay upon the Arch E F one after another.

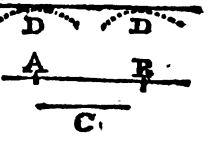



EXAMPLES.

Make an Angle, of 45°, and of 107°45′.

## PROBLEM VII.

227. *To draw a Line parallel to a given One* A B, *at any given Distance* C: With the Extent C, on E and F, describe the Areas D D; a Line touching the Tops of these is the Parallel required.

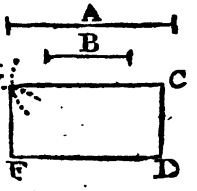



EXAMPLES.

Draw two Lines parallel, and distant from each other 38 Feet?

PROBLEM

## PROBLEM VIII.




228. *To make a Parallelogram with two given Lines* A *and* B: Make D F equal to A, and on one Extremity D, erect the Perpendicular D C equal to B; then on C with the Extent of A, and on F with the Extent B, make the Intersection G; draw C G, and F G, and 'tis done.

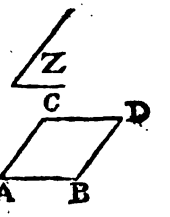
*Note*, When A and B are equal, the Parallelogram will be a *Square*, for the Construction of which, there needs no more Directions.

EXAMPLES.

1. Make a Parallelogram, the longest Side 85, and the shortest either 65, or 35?

2. Make a Square, each Side 25, or 85?

## PROBLEM IX.




229. *To make a Rhumbus on a Line* A B, *which shall have an Angle equal to a given One Z*: Make the Angle A, equal to Z; and on A set off the given Line A C = A B; on C and B with the Extent A B, make the Intersection D; join C D, and B D, and 'tis done.

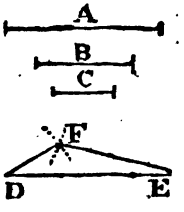
A *Rhumboides* is made in the same Manner.

EXAMPLES.

1. Make a Rhumbus with an Angle of 40°, and its Side 45 Feet?

2. Make a Rhumboides with an Angle of 45, and Sides 45 and 85 Feet?

## PROBLEM X.




230. *To make a Triangle with three given Lines*, A B C: Make D E equal to A; on D with the Extent C, and on E with the Extent B, make the Intersection F; join D F, E F, for the Triangle required.

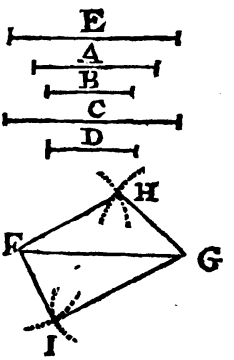
EXAMPLES.

EXAMPLES.

1. Make a Triangle, which shall have its three Sides respectively equal to 5, 6, and 8?

2, Make a Triangle, which shall have its Sides equal to 15, 10, and 19?

## PROBLEM XI.

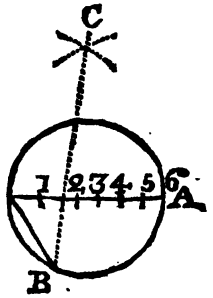



132. *To make a Trapezium, which shall have its Sides equal to four Lines,* A, B, C, D; *and its Diagonal equal to the Line* E: Make F G equal to E; upon F with the Extent of A, and upon G with the Extent of B, make the Intersection H; draw G H and F H; then on G with the Extent of C, and on F with the Extent D, make the Intersection at I; draw F I and G I, and 'tis done.

EXAMPLE.

Make a Trapezium with Lines equal in Length to the following Numbers, *viz.* 23, 25, 28, 16, and 32?

## PROBLEM XII.



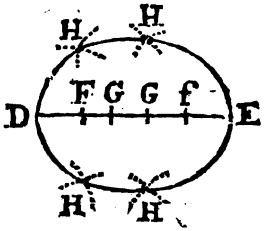

232. *To describe any regular Polygon in a Circle*: Divide the Circle's Diameter into so many equal Parts as the Polygon hath Sides; then with the whole Diameter on A and D, make the Intersection C; from which Point, draw a Line C B, through the End of the second Division, as at 2, it will assign a Point B; from which, if a Line be drawn to D, it will be the Side requir'd near enough the Truth.

EXAMPLES.

Describe a Polygon of either 8 or 10 Sides in a Circle?

PROBLEM

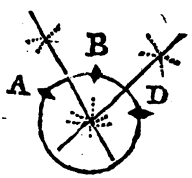
## PROBLEM XIII.




233. *To describe the Curve of an Ellipsis having given or assumed the transverse Axis* D E, *and the focal Points* F f: Take a Point in D E, as at G; with the Extent of E G on F, and with the Extent D G on f, make the Intersections H; these will be the Points of the Ellipsis, through which the Curve must be drawn.

The common mechanical Method of constructing this Figure, is to fix a Pin in each Focus, and a Third at the End of one of the Diameters; then tying a Thread fast about these three, they take out the Pin on the End of the Diameter, and carry it within the Thread, with a tight and steady Hand, round the two Foci, and thereby describe the above Curve exactly.

## PROBLEM XIV.

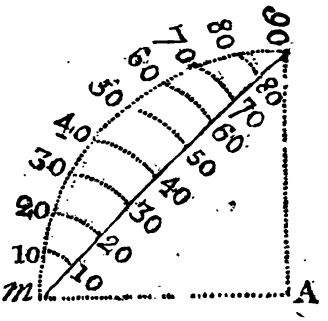



234. *To draw a Circle thro' any three given Points not lying in a strait Line, as* A B D: Bisect the Distance between any two Points, as A and B; also between the third, and either of these two, as B and D; the Point of Intersection of the bisecting Lines will be the Center of the Circle which pass through the given Points.

Hence having given the Segment of a Circle, the Whole may be found by taking three Points in the given Segment, and working as above.

PROBLEM

## PROBLEM XV.




235. *To make a Line of Chords:* Draw a Line A *m* which make Radius; upon A sweep the Arch *m*, 90; from *m* upon this Arch lay the Radius A *m* to 60, and take Half *A m* and lay from 60 to 90; divide the Arch 60, 90, into 3 equal Parts, and the Arch *m*, 60 into six equal Parts; when with one Foot of the Compasses in *m*, strike Arches from each of these Parts to the Line A 90.

*Note*, Every equal Part in the Arch should be divided into ten more.

## PROBLEM XVI.

236. *To take the Plan of any Curve, as an Arch, bended Hedge, &c. and to lay it down on Paper.*

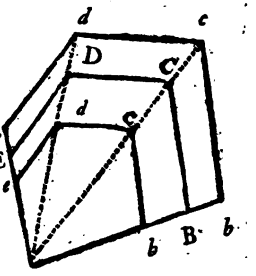
1. *To take the Dimensions:* Measure streight from S one End of the Curve S *e* T, towards T the other End, noting both the Distances S *a*, S *a*, &c. (where you measure perpendicularly from the Line S T to the Curve) and the Perpendiculars, *a e*, *a e*, &c. called Offsets.

2. *To plan these Dimensions:* Draw a Line T S, upon which, from a Scale of equal Parts, lay down all the Distances S *a*, S *a*, &c. upon these Points erect Perpendiculars, & set off the Offsets, *a e*, *a e*, &c. (taken from the same Scale of equal Parts) and thro' the Extremities, *e*, of these draw the Curve.

PROBLEM

## PROBLEM XVII.

237. *To change a Figure from one Scale to another*: From any Angle, as A, draw Lines, AC, AD, &c. to the Rest of the Angles of the given Figure: Augment or Diminish one Side AE in Proportion to the Scales and by Means of a parallel Ruler, from the Point *e*, draw *e d*, parallel to ED, meeting the Line AD (continued when necessary) in *d*: In the same Manner draw *d c* and *c b*, parallel to DC and CB, and you will have A *e d c b* A the Figure required.




☞ Those who want more to be said no PRACTICAL GEOMETRY, &c. we refer to Mr. FLETCHER's *Universal Measurer* and *Mechanic*.

# *Of* SUPERFICIAL MEASURE; OR, THE AREA *of* PLANE FIGURES.

238. "THE Area, or Measure of any Plane Surface, Geometrically considered, is the whole Space contained under the Bounds of the Figure, without any regard to thickness, as in the Mensuration of Land, Painters Work, &c. This Area, or superficial Content of the Space is computed from another Space of a determinate Form and Magnitude; that is, from a Square whose Side is one Inch, Foot, Yard, Rod, &c. called the *measuring Unit* and the Number of such *Squares* or *Units* (and Parts of an Unit) that are contained in any plane Figure, is called the *Content* or *Measure* of that Figure: But in the Subject of Guaging, where the *measuring Unit* is one Ale or Wine Gallon, or a Malt Bushel, it will be most commodious, in order to express the Area of a plane Figure in such Denominations, to consider the Plane (or rather *Solid*) to be just one Inch thick; by which Means, if the Number that expresses the Square Inches contained in any plane Figure be divided by the Number expressing the cubic Inches in the Ale or Wine Gallon, or Malt Bushel, we shall obtain

obtain the Area or Content of the Figure in thoſe Denominations."

"Though it is ſaid above, that any plane Figure will contain a number of little *equal Squares*, yet it is not to be underſtood that all plane Figures can be *formed* with a Number of ſuch Squares; but a Square (which can be ſo formed) may be found, whoſe Area ſhall be exactly (or nearly) equal to that of any plane Figure whatever."

"The very ſame is to be obſerved with reſpect to every Solid Figure (except a Cube) or a rectangular Parellelopipedon not being formed with a Number of little equal Cubes."

Before the Learner proceeds to ſolve the Examples in ſuperficial Meaſure, it is neceſſary that he obſerve the following Articles.

## *Of taking* DIMENSIONS, *&c. in* ARTIFICERS WORK, *&c.*

239. Beſides what is mentioned in Articles 16, viz. That Glaſs, Plank, &c. is meaſured by the ſquare Foot; Painting, Wainſcotting, Plaiſtering, &c. by the ſquare Yard; Flooring, Roofing, Tiling, Slating, Thatching, &c. by the Square of 100 Square Feet; and Brick Work by the Rod of 272¼ Square Feet; we have further to obſerve, the following *particular Cuſtoms* Artificers &c. obſerve in taking Dimenſions: In this we have conſulted the ſeveral Writers upon ſuch Subjects, and have gotten what Information we could, from the Workmen themſelves.

### 1. BRICKLAYERS WORK.

240. Before we enter upon the Methods made Uſe of by Bricklayers it may be proper to obſerve: That the digging out of Cellars or Foundations muſt be done before the Brick-Work can be begun: Alſo that this Digging is done by the ſolid Yard: And that the Dimenſions in Digging are ſeldom taken nearer than a Quarter of a Foot.

Bricklayers Work, properly ſpeaking, relates only to Work done with Bricks, and is commonly eſtimated by the Rod of 272¼ ſquare Feet. This Work tho' it hath its Contents given in ſquare Meaſure, is nevertheleſs, of various Thickneſſes; ſo that if Contents were to be reckoned according to their Surfaces, in all Thickneſſes, there muſt be a manifeſt Injuſtice done to ſome one, both with reſpect to Time and Materials: To prevent this, there is a particular Thickneſs fixed on to eſtimate this Work by, called the Standard Thickneſs; and this

this Standard is the Length of one Brick and Half, or three Times the Breadth of a Brick: So to estimate this Work observe this Rule: Multiply the superficial Content of the Wall in Feet, by the Number of Half Bricks in its Thickness; one Third of this Product is the Content in Feet, at the Standard Thickness.

Hence the Parts of a Wall, or a Building, which are of different Thicknesses, must be taken and reduced separately.

241. ORNAMENTAL WORK: Such as Arches over Doors, Windows, &c. Facias, Architraves, Rubbed Returns, Friezes, Cornices, Rustics, &c. Piers, Columns, Pilasters, &c. are valued by the Square Foot: By Ornamental Work, in common, is meant such as is *ground*, *gauged*, or *polished*: But if by Ornamental Work, carved Mouldings &c. is meant, it is necessary to observe, that such is often done by running Measure.

In taking Dimensions of Ornamental Work, which hath its Content found in square Measure, the Length is measured where it is greatest; and for the Height or Breadth, it taken both the Surface and Soffit; that is, the Distance from the Top of the Arch, streight down to the under Part of it, including in this, the Bottom home to the back Part of the Bricks. In like Manner Facias, Cornices, &c. are girt over all their Surfaces, including herein, both upper and under Returns: In short, every Part that appears is girt.

When two Walls join in an Angle, measure the Length of the one on the Outside, and the other on the Inside: Or you may take the Thickness of the Wall from the Sum of their Lengths. And to take the Dimensions of a Building, you may measure half round it on the Outside, and half round it on the Inside.

242. GABLE ENDS are Triangles, and therefore it is necessary to take the Breadth of the Base, and the perpendicular Height.

243. CHIMNEYS are measured as if they were solid, because of the Trouble attending them, the Vacancy between the Jaumbs, from the Hearth to the Mantle being only deducted,

If the Chimney stand in an Angle, or square Corner, Half the Product of the Height, into the Breadth of the Breast or Front, multiplied by the Number of Half Bricks in the perpendicular Distance of the Breast, from the Corner or angular Point, will be the Content.

Sometimes

Sometimes there are Burrs for the under Funnels on both Sides of the Corner, which are meaſured as a Wall.

The Trimmers that ſupport the Hearth are girt round the Arching for the Length, and are accounted Half a Brick thick.

244. CHIMNEY SHAFTS. If that Part of a Chimney which is above the Roof, be built with Brick, it is ſaid by ſome to be common to omit it in Meaſuring; and that Bricklayers meaſure the Height only to the Top of the Roof or Gable End, on Account of the Trouble of getting to meaſure them: Alſo, that in Conſideration of theſe Shafts, there is an Allowance made of ſo much for each Funnel, and that this Allowance is more or leſs according to the Height they are raiſed: But Others direct you to meaſure the Shafts as ſolid, on Account of the Trouble of Scaffolding, &c.

245. ARCHED ROOFS are generally, either *Vaults* or *Groins*.

VAULTED ROOFS are ſuch as ſpring from oppoſite Walls, &c. and are found in Churches, &c. Theſe may be repreſented by a hollow Cylinder cut in two through its Axis, and one Half placed with the Section Parallel to the Horizon.

GROINS are formed by Vaults interſecting one another.

246. A General RULE given to meaſure all Arches is this: With the greateſt external Breadth or Baſe of the Arch, as the Baſe (by ſome of the following Articles in Menſuration) find the Area of its End, conſidering the Space which is terminated by the ſaid Baſe Line, and the Surface of the End of the Arch, to be the Surface or Area required to be found; this Area multiplied into the Length will give the Content of a Solid of the ſame Dimenſions, with the Arch and its Vacuity taken together: But the Solid Content of the Arch is only wanted: Wherefore, if from this whole Content you deduct the Content of the Vacuity, (conſidered as a Solid, and found as before) there will remain the Content of the Arch.

But Workmen, in common, find a mean Breadth between the Upper and Under Side of the Arch, and multiply it into the Length.

147. In Groins the Trouble is more than in plain Work, and ſome ſay, that in order to make Compenſation to the Workman, both for Materials and Workmanſhip, he ſhould be allowed to charge for the Content of the Vacuity and Arch taken together; whilſt other intelligent People direct you to find the Content, (which may be eaſily done by ſome or other of the Rules in Menſuration) and add thereto ſo many

ny Square Feet, as the Interſections of the Arches are of running Meaſure.— In Bricklayers Work Deductions muſt be made for all Doors, *&c.*

## 2. CARPENTERS *and* JOINERS WORK

248. Conſiſts chiefly of the Outſide Carcaſe of Houſes, *&c.* Joiſting, Flooring, Partitioning, Roofing, Centering, Wainſcotting, Doors, Cornices, Door-Caſes, Windows, Stair-Caſes, *&c.*

249. The Outſide CARCASE of HOUSES: When the Body of a Building is all Timber, it is meaſured by the Square of 100 Square Feet, and the Length of one ſide and one End is generally taken and multiplied into the Height (taken from the Under Side of the Cell to the Upper Side of the Raiſing) for the Content of one Side and one End; the Double whereof is the Content of the Body of the Building.

250. JOISTS and GIRDERS: For Joiſting, *&c.* take the Length of the Room, and what the Joiſts are let into the End Walls for the Length; and the Breadth of the Room, and what the Girders are let into the Side Walls, for the Breadth.

251. FLOORING: For Flooring find the Content of the Room within the Walls.

When Flooring and Joiſting are each nearly of the ſame Value, the Length of the Room, added to what one of the Joiſts are let into the Wall, is the Length; and the Breadth of the Room, and what the Girders are let into the Wall is the Breadth.

Upon Account of Waſte, Trouble, *&c.* about Hearths no Deduction is made for the Space the Slab takes up.

252. PARTITIONING. In this Work the Content is according to its Length and Breadth, &c.

No Deductions are made in Workmanſhip, for Door-ways, &c. becauſe of the Trouble of Framing them.

253. ROOFING. In this Branch you are directed to multiply the Length of the Building by the Length of the Raſter, and twice the Product is the Content; and this will hold good according to ſome, whether the Ends are Gable or Hipt: But this appears to me to be demonſtrably falſe, in the laſt.

In Caſe of any Hips or Vallies, after having taken the true Area, it will be found reaſonable to make ſome Allowance for the Waſte of Time and Materials in forming them: Hence ſome direct to take one Third of the triangular Parts and add

to

to the Content; whilſt other have ſuch Allowance as they can Bargain for.

☞ This Method of Meaſuring naked Floors, Roofs, &c. by the Square, is eſteemed by ſome of very little Service; ſince (ſay they) it is a much better Way, and more correct to take the Dimenſions of all the Timbers and abſtract them into one general Head of Cube Feet, and to put a Price to them according to the Nature of the Work.

254. COMMON VAULTED CENTERING. In this take the Breadth of the Surface of the Infide of the Arch for one Dimenſion and the Length of the Arch for the other.

255. WAINSCOTTING. In this Branch take the Compaſs of the Room for the Length; and for the Breadth, meaſure with a Line the Height thereof, indenting it whereſoever the Plane hath touched the Surface.

Deductions for Materials are to be made out of this for Chimneys, Doors, Windows, &c. which Articles, with the Cheeks of Windows, Cheeks, Sopha's, Linings, &c. are to be taken and meaſured by themſelves.

The above uſed to be the Method of taking the Dimenſions over all Mouldings, &c. on Wainſcott, which are now generally paid for ſeparately by the ſquare Foot, if not agreed to be included in the Meaſuring of the Wainſcott.

256. FRAMED DOORS. In Doors, the Length, Breadth, and Thickneſs is conſidered with Reſpect to Materials: And when 'tis two Inch Stuff, and both Sides pannelled, their Area is allowed for Workmanſhip: But in Doors which have only one Side pannelled, and the other ſimply planed, the Area and half Area of one Side is allowed.

Window Shutters are meaſured and valued in the ſame Manner as Doors.

257. All CORNICES, ARCHITRAVES, CHIMNEY PIECES, BASE MOULDING, SUBBASE, and all other MOULDINGS, are girt with a String about their Surface and Soffit, and all which appears without; and this Girt is multiplied into the Length for the Content.

For CIRCULAR MOULDINGS they formerly uſed to be allowed double Meaſure, but now are generally allowed treble Meaſure.

258. DOOR CASES: Theſe are girt round the Architraves, and Inſides of the Jaumbs for the Breadth, and for the Length add the Length of the two Jaumbs to the Length of the Cap-Piece, taking the Breadth of the Opening for the Length thereof.

259. In

259. WINDOWS. In Windows they take their greatest Length, and multiply into their greatest Breadth.

260. STAIRS. For Stairs the common Directions are to take a String and girt over the Riser and Tread, to multiply that by the Length of the Step, and that Product by the Number of Steps for their Area; to which you are to add the Area of the Landings, or half Paces for the whole Area. But Steps which have their Contents thus found, are only such as go directly from one Floor to another, without turning either to the Right or Left: Such Directions being insufficient for another Sort unless the Girt is limited to be taken in the Middle of the Step.

There are some Articles in Carpenters and Joiners Work lued and done by Lineal Measure: Also others, and even some of the before-mentioned are generally taken by the Job.

## MASONS WORK.

270. MASONS WORK is measured by the Foot, either superficial or solid, and sometimes by both.

By the Foot Solid are measured Blocks of Marble, or any Kind of Stone, Columns, Cornices, *&c.* and by the Foot Superficial are measured Pavements, Slabs, Chimney-Pieces, and the like.

The Solid Measure is for Materials, and the Superficial Measure of these Materials for Workmanship.

It must be observed, that the Articles which are measured by the superficial Foot only, are those which are of such a Thickness; such as are more than this Thickness, are measured by the solid Foot for Materials, and by the superficial Foot for Workmanship.

Masons for Workmanship take their Dimensions by pressing a String into all the Mouldings, and girting all upper and under Returns.

## TYLERS and SLATERS WORK.

271. In this Work 'tis common to find Contents by considering the Sides of a House, either as Parallelograms, or Trapeziods and Triangles; and in case of Hips and Vallies, to add so many square Feet to that Content, as the Hips and Vallies are of running Measure.

Slaters, besides the Girt from Eave to Eave, as in Tyling, add the Length of the Row of Slates at the Eaves, which are lain double, or allow three Inches, or thereabouts, at each Eave instead of it.

No Deductions for Labour are made in this Work for Chimneys, &c. neither should Deductions take Place with Regard to Materials, unless the Chimneys, &c. are of a considerable Area, in which Case an Allowance should be made both for Materials and Workmanship.

## PLAISTERERS WORK.

272. Plaisterers Work is generally measured by the Square Yard, tho' some of it, as *enriched Mouldings*, &c. is measured by the running Foot.

Plaisterers Work is mostly of two Kinds, *viz.* Work Lathed and Plaistered, called *Cieling*; and Work upon Walls only, called *Rendring*.

In this Work they are paid according to the Coats of Plaister laid on: And they deduct for Doors, Windows, Chimneys, and wherever they have used no Plaister.

## GLAZIERS WORK.

273. Is generally taken so near as the 8th or 10th of an Inch, &c. and the Dimensions extend the whole Length and Breadth of the Glass, including the Lead, when any; and at some Places they include the cross Bars belonging to Sashes with the Glass between the Panes. Also when Windows have curved Forms, &c. because of extraordinary Trouble, Waste of Glass, by cutting it into such Forms, &c. no Allowance is made for such Curvature; but in arched Windows, Glaziers take from the highest Part a Perpendicular to the Bottom of the Window for the Height, which they multiply into the greatest Breadth of the Arch for the Content. In circular Windows, they square the Diameter for the Content: And in oval Windows they take the Product of the Transverse and Conjugate, or two principal Diameters for the Content.

## PAINTERS WORK.

274. Painters take their Dimensions as the Joiners do, and are paid for every Place their Brush comes to, or their Colour is used at.

Sash Frames, Casements, &c. are done at so much each.

For Modilion, and other outside Cornices, they are paid at so much per Foot running Measure.

Carving in Rooms and outside Frontispieces to Doors, &c. are so various, that they must be valued by the Time and Materials expended.

In this Work they are paid according to the Coats or Number of Times the Work hath been painted over.

## PAVERS WORK.

275. This is done by the Square Yard, and the Length is multiplied into the Breadth for the Content.

## PLUMBERS WORK.

276. This Work is generally done by the Pound or Hundred Weight, there being no general Rule for discovering the Weight by Measure, on Account of the Difference of Weight in Lead, which will measure the same: And though you may think of knowing what Weight any particular Area will be, if you know the Weight of any other Area of the same Lead, even in this you may be deceived, as Lead cannot be cast so as to be of an even Thickness throughout every Part.

## LAND MEASURE.

277. In LAND MEASURE they take their Dimensions in common with what is called a *Gunters Chain*, which is 66 Feet in Length, and consists of 100 equal Parts or Links, each of which being 7·92 Inches. This Division of their Chain in to 100 equal Parts makes the Chains and Links work together in every Respect as Decimal Fractions.

In several Parts of *England* they use Poles of different Lengths, for taking Dimensions called Customary Poles; but in all Places 40 square Poles make one Rood, and 4 Roods an Acre; so the Difference is in the Pole only, now to reduce Customary to Statute Acres.

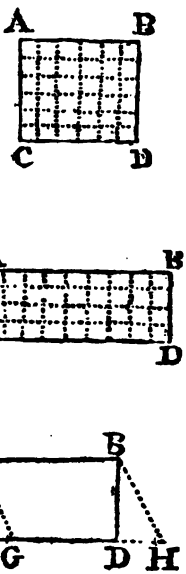
Observe this RULE.

As the Square of the Feet in a Customary Pole is to any Number of Customary Acres, so is (inversely) the Square of the Feet in a Statute Pole to the Statute Acres (which are equal in Content to the given customary Ones) and the Contrary.

After Perusal of the foregoing Customs, the Examples to the following Rules, on considering that Measures are reduced from one Name to another by Article 22, will appear easy.

282. *To find the Area of a* PARALLELOGRAM, *whether it be a* SQUARE, *a* RECTANGLE, *a* RHUMBUS, *or a* RHUMBOIDES.

If the Sides of a Rectangle, or Square, as A, B, C, D, be divided into so many equal Parts as they respectively contain *linear measuring Units:* And if Lines be drawn from the opposite Points of these Divisions, the Figure will contain such a Number, of *superficial*, or *square measuring Units*, (which are the Area thereof by Ar. 238) as is denoted by the Product of its Length into the Breadth, or perpendicular Height, taken in the aforesaid linear Measure: But the oblique Parallelogram A B G H is equal the Rectang'e A B C D, because the Triangles G C A, and B, H, D, are equal: Wherefore as the perpendicular Height & Length of these Parallelograms are equal, the Area of every Parallelogram is obtained by this Rule, *viz.*




Multiply the Leng h by the perpendicular Height or Breadth:

That is, A B × A C = the *Area.*

EXAMPLES.

1. What is the Area of a Square in Acres, which hath each Side 14·5 Chains? *Answ.* 21 Acres, 0 Roods, 20 Poles.

2. What is the Area of a rectangular Piece of Ground, 12·5 Chains in Length, and 4·3 Chains in Breadth? *Answ.* 5*A.* 1*R.* 20*P.*

3. If the Side of a Square be 24·5 Inches, what its Contents in Beer and Wine Gallons? *Answ.* 2·12854609, &c. Gallons of Beer, and 2.59848 Gallons of Wine.

4. What is the Area of a *Rhumbus* or *Rhumboides*, 28 Feet in Length, and 2·5 Feet in perpendicular Height? *Answ.* 70 Feet.

5. What is the Content of a Piece of Glass, in the Form of a *Rhumbus*, or *Rhumboides*, which is in Length 2*F.* 10*P.*

6*S.*

6S. and in perpendicular Height 1*F.* 9*P.* *Answ.* 5*F.* 0*P.* 4*S.* 6*T.*

6. How many Square Inches are contained in a Marble Slab which hath its Dimensions 40 by 21 Inches? *Answ.* 840.

7. How many Square Feet, &c. in a Plank which hath its Dimensions 15*F.* 11*P.* by 11*P?* *Answ.* 14*F.* 7*P.* 1*S.*

8. How many Square Feet and Yards in a Pavement which hath its Dimensions 18 Feet by 22? *Answ.* 396 square Feet, and 44 square Yards.

9. How many Square Yards in a Cieling 173·5 Feet by 20·25? *Answ.* 390·375 Yards.

10. If a Piece of Glass be 20·5 Feet by 4·5 how many Sq. Feet doth it contain? *Answ.* 92·25.

11. How many Square Yards are in a Piece of either Wainscot, Painting, Paving, &c. which is 25·5 Yards by 12·25? *Answ.* 311·375.

12. How many Squares of Work, of 100 Square Feet, are in a Floor 120 Feet by 43? *Answ.* 51·6.

13. How many Square Rods, &c. of Brickwork, at 1½ Bricks in Thickness, are in a Wall which is in Length 251 Feet, Height 12 Feet, and 3½ Bricks in Thickness? *Answ.* 25*R* 228*F.*

14. If the Breadth of a Roof, with the usual Allowance at the Eaves, be 25·5 Feet, and the Length of the Ridge 54 Feet, how many Yards square, Rods of 49 square Yards, and Squares of 100 square Feet, are in that Roof? *Answ.* 153 square Yards, 3 Rods, 6 Yards, and 13 Squares 77 Feet.

15. If the Compass of a Room be 47·2 Yards, and the Height 8 6 Yards, what the Content? *Answ.* 495·556 square Yards.

16. If the Compass of a Room be 76*F.* 3*I.* and the Height (girt over the Mouldings) 8 *F.* 6 *I.* how many square Yards are therein? *Answ.* 72*Y.* 0*F.* 1*P.* 6*S.*

17. If the Window Shutters about a Room be 54 *F.* 6 *I.* broad, (*i. e.* all their Breadths in one Sum equal to 54*F.* 6*I.*) and the Height of each Shutter 5*F.* 6*I.* how many Yards is the Content at Work and half Work? *Answ.* 49*Y.* 8*F.* 7*P.* 6*S.*

18. How many Rods of 16½ Square Feet are contained in a Wall which is 43 Feet 6 Inches long, and 10 Feet 6 Inches high? *Answ.* 27 Rods, 11¼ Feet.

19. How many Square Rods of Work in a Wall which is in Length 507 Feet, Height 5 Feet, and Bricks in Thick-

neſs at either 4, 3, $2\frac{1}{2}$, or 2? *Anſw.* at 4 Bricks 24 Rods

20. How many Deal Boards, 9 Feet 10 Inches long, and 10 Inches wide, will Floor a Room 18 Feet by 10? *Anſw.* $21\frac{57}{72}$.

21. Suppoſe the ſuperficial rubbed and guaged ſtreight Arches to 13 Windows are each 3 Feet 6 Inches long, and 1 Foot broad, what is their whole Content? *Anſw.* 45 Feet 6 Primes.

22. Suppoſe the Dimenſions of the Soffites to the Arches of theſe 13 Windows to be each 3 Feet long, and 6 Inches wide, what is their ſuperficial Content? *Anſw.* 19 Feet 6 Primes.

23. If the Stone Plinth, String and Facia of a Building be 208 Feet long, and the Height with the Projections out of the Wall 3 Feet 1 Inch broad, what is the ſuperficial Content? *Anſw.* 641 Feet 4 Primes.

24. If the Length of a Moulding be 180 Feet, and its Breadth 2 Feet 6 Inches, what is the ſuperficial Content? *Anſw.* 450 Feet.

25. Suppoſe the moulded Edge of a Copeing be 192 Feet long, and 6 Inches wide, what the ſuperficial Content? *Anſw.* 96 Feet.

26. If the plain Jaumbs and Soffite of the Architrave of a Door be 20 Feet long, and 8 Inches wide, what is the ſuperficial Content? *Anſw.* 13 Feet, 9 Primes, 4 Seconds.

27. If the plain Front and Projection of a Pilaſter be 7 Feet 9 Inches high, and 6 Inches wide, what is the ſuperficial Content? *Anſw.* 3 Feet, 10 Primes, 6 Seconds.

28. Suppoſe a moulded-raking Cornice be 7 Feet long, and 1 Foot 6 Inches wide, what is its ſuperficial Content? *Anſw.* 10 Feet 6 Primes.

29. Suppoſe the upper Face of a level Cornice to be 5 Feet 6 Inches long, and 8 Inches wide, what is the ſuperficial Content? *Anſw.* 3 Feet 8 Primes.

30. Suppoſe the Marble Mantle and Jaumbs of a Chimney to be 9 Feet 9 Inches long, and 11 Inches wide, what their ſuperficial Content? *Anſw.* 8 Feet, 11 Primes, 3 Seconds.

31. Suppoſe the Marble Slab to a Chimney to be 4 Feet 6 Inches long, and 2 Feet broad, what is its ſuperficial Content? *Anſw.* 9 Feet?

32. If the back Slab to a Chimney be 2 Feet 6 Inches long, and 1 Foot 6 Inches wide, what is its ſuperficial Content? *Anſw.* 3 Feet 9 Primes.

33. Suppoſe

33. Suppose the Length of the Dado or plain Part round a Room to be 48 Feet, 4 Inches, and its Height 2 Feet, what is the superficial Content? *Answ.* 96 Feet 8 Primes.

34. Suppose the Girt of the Mouldings to a Pedestal be 1 Foot 5 Inches, and the Length 48 Feet 4 Inches, what is the superficial Content? *Answ.* 65 Feet, 5 Primes, 8 Seconds.

35. Suppose a Room with Ovolo and flat Pannels, with broad Margins, to be 62 Feet 4 Inches round, and its Height from the Top of the Pedestal to the under Side of the Cornice (with one Inch at Top and Bottom as an Allowance for Nailing) 7 Feet 10 Inches, what is its Content? *Answ.* 488 Feet, 3 Primes, 4 Seconds.

36. What is the Content, at one Inch deep, of a Floor in Corn or Malt Bushels, which is in Length 2150·42 Inches, and in Breadth 700 Inches? *Answ.* 700 Bushels.

*Note*, One Pound of

| | | |
|---|---|---|
| Tallow Gross, is | =30·28 | Solid Inches. |
| Tallow Nett | =31·4 | |
| Hard Soap | =27·14 | |
| Green Soft Soap | =25·67 | |
| White Soft Soap | =25·56 | |
| Green Starch | =34·8 | |
| Dry Starch | =40·3 | |

37. If the Length of a Rectangle be 171 Inches, and its Perpendicular 58 Inches, what is its Area in Corn Gallons and Pounds of Tallow Nett? *Answ.* 8·618970 Corn Gallons, and 315·8 Pounds of Tallow Nett.

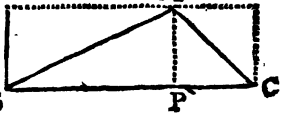
### 278. *To find the Area of a* Triangle.

A Triangle being Half of a Parallelogram of the same Length and Height, the Rule will be,

Multiply one of its Sides by a Perpendicular let fall from its opposite Angle, and Half the Product is the Area. Or, One into Half the other gives it;

That is, $\frac{BC \times AP}{2} = \frac{1}{2} BC \times AP = BC \times \frac{1}{2} AP = Area.$

*Note*, In all right-angled Triangles, the Square of the Hypothenuse is equal to the Sum of the Squares of the other two Sides; consequently the Difference of the Squares of the Hypothenuse, and either Side, is the Sq. of the other Side.



3. Suppose the Parallel Sides to be 2·8 and 2·5 Chains, and their Perpendicular Distance 8·5 Chains, what the Content? *Answ.* 225·25 Square Chains.

4. What is the Content of a Board which hath its Ends or Parallel Sides, the one 17 and the other 11 Inches, & Length or Perpendicular Distance between them 11 Feet 2 Inches? *Answ.* 13 *F.* 0 *P.* 43.

5. Suppose the Parallel Ends of a Board to be 21 and 15 Inches, and their Perpendicular Distance 24 Feet, what its Content? *Answ.* 36 Feet.

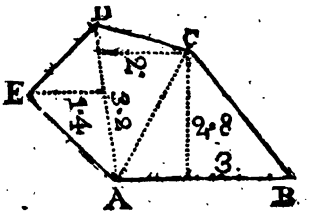
6. Suppose the Length of the Ridge of a Roof, with two hipt Ends, to be 24 Feet, the Length of each side Eave 32 Feet, the Breadth of a Side of the Roof 12 Feet, and the Length of an End Eave 16 Feet, how many Squares of Slating in this Roof, allowing, over and above the foregoing Dimensions, 3 Inches in Breadth for the lowest Row of Slates, and, besides the Content of such increased Dimensions, so many Feet of Square Measure as the Hips are of Running Measure? *Answ.* 9 Squares, 23·6+Square Feet.

281. *To find the Area of an* IRREGULAR POLYGON.

Divide it into Triangles, Trapeziums, *&c.* as the Figure requires, and find the Area of each, their Sum is the Area sought.

EXAMPLES.

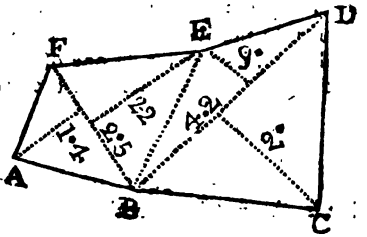
1. What is the Area or Content in Acres, *&c.* of the three following Figures, supposing their Dimensions to be taken in Chains and Decimal Parts of Chains.



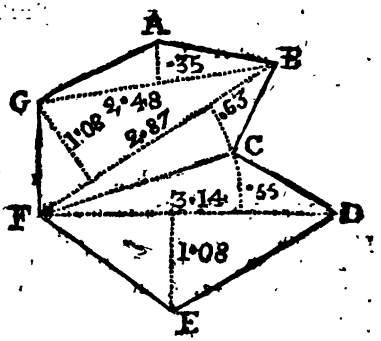

1. *Answ.* 3 Roods, 34·24 Poles.

2. *Answ.*

2. *Answ.* 1 Acre, 0 Roods, 9·44 Poles.




3. *Answer*, 2 Roods, 7·15 Poles.




4. Suppose in the Figure A B C D E the Diagonal of the Trapezium A C D E had been given = 4·5 Chains, and the Perpendiculars respectively = 3 and 2·25 Chains; also in the Triangle A B C the Base and Perpendicular had been 4 Chains and 2·27 Chains, what is the Content? *Answ.* 1 Acre, 3 Roods, 13·64 Poles.

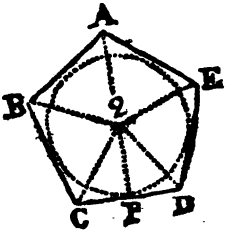
5. Suppose in the Figure A B C D E F that the Diagonals B F and B D had been respectively equal to 3·88 and 5·72 Chains; also that the Perpendiculars which fall upon the Diagonal B F had been 3·5 and 2·87 Chains respectively; and that the Perpendiculars which fall upon B D had been respectively equal to 4 and 2·2 Chains, what the Content? *Answ.* 3*A.* 0*R.* 1·43*P.*

282. *To find the Area of a* Regular Polygon.

A Regular Polygon will contain so many equal Triangles as it hath Sides: But the Perpendicular let fall from the Center of the Polygon (or Center of its inscribed Circle) to each

Side, and theſe Sides, are the Perpendiculars and Baſes of the Triangles: Therefore the Rule will be,

Multiply the Ambit of the Figure by the Perpendicular, let fall from its Center on one of its Sides, Half the Product is the Area: Or one into half the other gives it;




That is, (by putting C=the Ambit of the Polygon) $\frac{C \times QP}{2} = \frac{1}{2} C \times QP = C \times \frac{1}{2} QP$ = the Area.

EXAMPLES.

1. If each Side of a regular Pentagon be 10, and the Perpendicular 6·8819, what the Area? *Anſw.* 172·047.

2. If each Side of a regular Hexagon be 64, and the Perpendicular 55·42, what is its Area? *Anſw.* 10640·64.

3. If each Side of a regular Pentagon be 500 Feet, and the Perpendicular 344·094+Feet, what the Area? *A.* 430117·5 ſquare Feet.

4. If each Side had been (in the laſt Example) 14·6, and the Perpendicular 10·04741 + what the Area? *Anſwer,* 366·7353852.

5. If each Side of a regular Heptagon be 10, and its Perpendicular 10·3826. what the Area? *Anſw.* 363·3912.

6. If each Side of a regular Decagon be 10, and its Perpendicular 15·388418, what is its Area? *Anſw.* 769·4209.

A TABLE

A TABLE *for finding the Area of a* POLYGON.

| Number of Sides. | Names. | Multipliers or Area when the Side is one. |
|---|---|---|
| 3 | Trigon | 0·433013 |
| 4 | Square | 1· |
| 5 | Pentagon | 1·720477 |
| 6 | Hexagon | 2·598076 |
| 7 | Heptagon | 3·633912 |
| 8 | Octagon | 4·828427 |
| 9 | Nonagon | 6·181827 |
| 10 | Decagon | 7·694209 |
| 11 | Undecagon | 9·365641 |
| 12 | Duodecagon | 11·196152 |

283. *To use the Table:* Multiply the Square of the given Polygon's Side by the Tabular Number belonging to that Polygon, the Product is the Area.

EXAMPLES.

1. A Piece of Garden Box lies in the Form of a Regular *Pentagon*, each Side whereof being 48 Feet, I demand its Area? *Answ.* 3962·88+

2. If the Side of a Regular *Hexagon* be 35, what is its Area? *Answ.* 3182·55+

3. If the Side of a Regular *Heptagon* be 10, what is its Area? *Answ.* 363·3912.

4. If the Side of a Regular *Octagon* be 25, what is its Area? *Answ.* 3017.7668+

5. If the Side of a Regular *Hexagon* be 20 Yards, what is its Area? *Answ.* 1039·2304 square Yards.

6. If the Side of a Regular *Nonagon* be 25, what is its Area? *Answ.* 3863·641875.

284. *To find the* DIAMETER *of a* CIRCLE, *having the* CIRCUMFERENCE *given, and the contrary:*

Multiply the Diameter by 3·1416, and the Product is the Circumference; consequently any Circumference, divided by 3·1416, or which is the same multiplied by ·318309, gives the Diameter.

EXAMPLES.

EXAMPLES.

1. What is the Circumference of a Circle which hath its Diameter 7? *Answ.* 22 nearly.

2. What is the Circumference when the Diameter is 113? *Answ.* 355 nearly.

3. If the Diameter of a Circle is 100, what is the Circumference? *Answ.* 314·16.

4. If the Diameter of a Circle is 32, what is the Periphery? *Answ.* 100·5312.

5. If the Periphery of a Circle be 251·328, what is its Diameter? *Answ.* 80.

6. If the Circumference of the Earth, supposing it a Globe, be 129630573 Feet, how many Miles the Diameter? *Answ.* 4189196·061057.

7. If the Diameter of a Circle be 960, what is its Circumference? *Answ.* 3015·936.

285. *To find the Area of a* CIRCLE, SEMI-CIRCLE, QUADRANT, *or* SECTOR.

A Circle, &c. may be considered as a Polygon of an infinite Number of Sides: Therefore the Rule will be,

Multiply Half the Circumference or Arch by Half the Diameter or Radius: Or take ¼ of the whole Product for the Area.

If the Diameter of a Circle be 1, the Periphery is found to be 3·1416 nearly, and therefore per last Rule the Area of such a Circle will be ·7854 nearly: And because Circles are like Figures, we have, as the Square of 3·1416, the Periphery of a Circle which hath its *Diameter* 1: ·7854 its Area :: the Square of 1: ·07958 the Area of a Circle which hath its *Periphery* 1. Hence

286. *To find the Area of a* CIRCLE:

Multiply either the Square of its Diameter into ·7854, or the Square of its Periphery into ·07958 for the Content.

EXAMPLES.

1. If the Circumference of a Circle be 314·16, and the Diameter 100 Feet, what is its Area? *Answ.* 7854 square Feet.

2. If the Diameter of a Circle be 60 Yards, what is its Area? *Answ.* 2827·44 square Yards.

3. If the Diameter of a Circle be 16 Poles, what is its Area? *Answ.* 201·0624 square Yards.

4. If

4. If the Circumference of a Circle be 71, what is its Area? *Answ.* 401·16278.

5. If the Circumference of a Circle be 34½ Feet, what is its Area? *Answ.* 94·72 square Feet.

6. If the Diameter of a Circle be 30, what is its Area? *Answ.* 706·86.

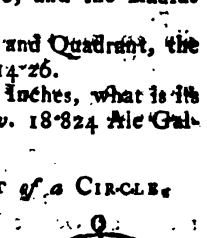
7. What is the Area of the Sector of a Circle, which hath its Arc 30 Feet, and Radius 15? *Answ.* 225.

8. Suppose the Arc of a Sector to be 30, and the Radius 15, what is its Area? *Answ.* 180.

9. What is the Area of a Semi-circle and Quadrant, the Radius being 40? *Answ.* 628·32 and 314·16.

10. If the Diameter of a Circle be 80 Inches, what is its Area in Ale and Wine Gallons? *Answ.* 18·824 Ale Gallons, and 21·7536 Wine Gallons.

287. *To find the Area of a* SEGMENT *of a* CIRCLE.




Find per last Article the Area of the Sector R C O P, having the same Arch with the given Segment, and to or from which, according as the Segment is greater or less than a Semi-circle, add or take the Area of the Triangle R C P, formed by the Radiuses of the Sector and Chord of the Segment for the required Area.

But if it be troublesome to find the Arc of the Segment, instead of the foregoing, use the following Rule.

Multiply the Sum of the Chord of the whole Arc, and of the Chord of Half the Arc, into ⅔ of the versed Sine; the Product is the Area *nearly*.

That is, $C+\frac{4}{3}c\times 4v=C+\frac{4}{3}\sqrt{D v}\times 4v=C+\frac{4}{3}\sqrt{\frac{1}{4}C^2+v^2}\times 4v=$ Area; wherein $D$ denotes the Diameter, $C$ the Chord of the Whole Arc, $c$ the Chord of ½ the Arc, and $v$ the versed Sine or Height of the Segment.

EXAMPLES.

1. What is the Area of the Segment C O P, which hath its Arc 28·656, versed Sine or Height 6, Radius of the Circle 16, and Chord 24·98 Feet? *Answ.* 104·348.

2. What is the Area of both Segments of a Circle cut off by a Chord of 90°, the Diameter being 16 Feet? *A.* the Area of the greatest Segment is 182·7968, of the least 18·2656.

3. Wha-

3. What is the Area of the Segment of a Circle which hath its Chord 40, and versed Side 10? *Answ.* 279·57.

4. Suppose the Arc of the Segment 63, its Height 1·82, Radius of the Circle 30, and Chord 20·583, what is the Area? *Answ.* 24·98.

5. What is the Area of the Segment which hath its Chord 35, and versed Sine 9·6? *Answ.* 236·06.

6. What is the Area of the Segment which hath the Radius 40 Inches, and its versed Sine 10? *Answ.* 982.6.

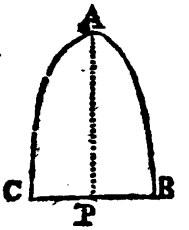
7. What is the Area of the Segment which hath the Radius 20, and versed Side 5? *Answ.* 61·4184.

8. What is the Area of the Segment which hath the Diameter 50 Inches, and its versed Sine 11? *Answ.* 320 2825 square Inches.

### 288. *To find the Area of a* Parabola.

Multiply the Altitude into the Base, $\frac{2}{3}$ds of the Product is the Area: Or one into $\frac{2}{3}$ of the other gives it.

That is, $\overline{AP \times CB} \times \frac{2}{3} = \frac{2}{3} AP \times CB =$ $AP \times \frac{2}{3} CB =$ Area.




Examples.

1. Suppose the Base of a Parabola to be 32, and the Altitude 18 Yards, what is its Area? *Answ.* 384 square Yards.

2. Suppose the Base 144 Feet, and the Altitude 96 Feet, what is its Area? *Answ.* 9216 square Feet.

3. Suppose the Base be 24, and the Altitude 8 Feet, how many square Yards is the Content? *Answ.* 128.

4. Suppose the Base to be 96, and the Altitude 64 Feet, what is its Area? *Answ.* 4096 square Feet.

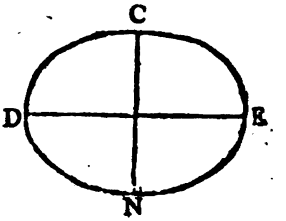
5. If the Base be 24, and the Height 33, what is the Area? *Answ.* 528.

6. If the Base be 15·6, and the Height 10·5, what is its Area? *Answ.* 109·2.

289. *To find the Area of an* Ellipsis.

Multiply the Transverse, or longest Diameter, by the Conjugate or shortest Diameter, and this Product by ·7854.

That is, DE×CN×·7854= Area.




Examples.

1. If the transverse Diameter of an Ellipsis be 25·6, and and the Conjugate 10 Yards, what is the Area? *Answ.* 201·0624 square Yards.

2. If the transverse Diameter be 120, and the Conjugate 30 Yards, how many square Yards is the Content? *Answ.* 2827·44.

3. If the transverse Diameter be 36, and the Conjugate 25, what is the Content? *Answ.* 706·86.

4. If the transverse Diameter is 50, and the Conjugate 20, what is the Content? *Answ.* 785·4.

5. Suppose the longest or transverse Diameter to be 554·4 Feet, and the Conjugate or shortest 403·92 Feet, what is the Area? *Answ.* 175877·17 square Feet, or 4 Acres 6 Perches, equal the Area of the Ellipsis in Grosvenor-Square, London, Walls.

6. Suppose the Diameters in the last Example had been 556·73 and 406·253 Feet respectively, what is the Area? *Answ.* 177637·66 square Feet, equal to the Area of the before-mentioned Ellipsis more by the Area covered by the Walls; consequently, if the Ground was enclosed by one continued Wall, such Wall would stand on 1760·49 square Feet.

7. Suppose the transverse Diameter to be 80, and the conjugate Diameter 20, what is the Area? *Answ.* 1256·64.

8. If the Transverse be 21 Inches, and the Conjugate 15·6 Inches, what the Area? *Answ.* 257·29705.

☞ Here we might procced to give Rules for Elliptical, and other Segments, *&c.* which, when given, we presume would be of little Service in Practice, since their Forms must be known

known before the proper Rule can be applied: Wherefore, instead of these Rules we shall first shew how they generally find the Content of a curved Piece of Ground, and then shew how the Area of any curve-lined Space may be approximated to by the Method of equidistant Ordinates.— First then,

290. *To find the Content of any curved Piece of Land.*

The common Method is, Measure in a right Line from one End of the Figure to another, and at right Angles to this Line, take as many Breadths as necessary, remembering especially to take the greatest and least Breadths; add all these Breadths together, and divide the Sum by the Number of them; multiply the Quotient by the Length of the aforesaid right Line, and the Product is the Content. Or you may find the Area of every Part, that the Figure will be divided into by these Lines, by Articles 284 and 286.

But to be more exact, we shall secondly give a RULE.

291. *To approximate to the Area of any curve-lined Space, with any odd Number of equidistant perpendicular Ordinates, viz.* "To the Sum of the first and last, or two extreme Ordinates, add four Times the Sum of the even Ordinates, *viz.* of the Second, Fourth, Sixth, &c. and also double the Sum of all the rest, this Total being multiplied by $\frac{1}{3}$ of the common Distance of the Ordinates, gives the Area required, *nearly.*"

That is, $\frac{AB}{3} \times A v + 4 B n + 2 C p + 4 D e + 2 E f + 4 F g + G b = A$rea, which will become by putting A for the extreme Ordinates, B for the Sum of the even Ordinates, C the Sum of the rest, and D their common Distance; $\frac{A+4B+2C}{3} \times D = \overline{A+4B+2C} \times \frac{1}{3} D = \frac{1}{3} \overline{A+4B+2C} \times D =$ the Area.

292. But to find the Area and Solidity of a Curve by *any Number* of equidistant perpendicular Ordinates, or Sections;

put

put $L$ for the Length of the Base, $A$ the Sum of the first and last Ordinates or Sections, $B$ of the second and last but one, $C$ of the third and last but two, *&c.* and the last of the Letters denotes the Middle Term when the Terms are odd: Then

When Equidistant Ordinates are taken, the Area is

| | |
|---|---|
| 2 | $A \times \frac{1}{2} L.$ |
| 3 | $: A + 4B : \times \frac{L.}{6}$ |
| 4 | $: A + 3B : \times \frac{L.}{8}$ |
| 5 | $: 7A + 32B + 12C : \times \frac{L.}{90}$ |
| 6 | $: 19A + 75B + 50C : \times \frac{L.}{288}$ |
| 7 | $: 41A + 216B + 27C + 272D : \times \frac{L.}{840}$ |
| 8 | $: 751A + 3577B + 1323C + 2989D : \times \frac{L.}{17280}$ |

*&c.*

**In common Practice three Ordinates or Sections may be sufficient, although the more there are taken the truer will the Content be.**

*Note,* When there are many Ordinates given, you may reduce them to a less Number, by adding together the first and last, the second and last but one, the third and last but two, and so on; considering these Sums as Ordinates to a Base one Half of the given One. Otherwise there may be added together the two first and two last Ordinates, and the two Pairs of Ordinates next to these, *&c.* Or there may be taken together the three first and three last, and then the next Pair of Three's to these, *&c.* remembering to diminish the Length of the given Bases, in Proportion to the Number of the given Ordinates, that are added into each Sum: The Contents in each Case will not be very different.

## Examples.

1. Suppose there are given 5 perpendicular equidistant Ordinates, $A\,v$, $B\,n$, $C\,p$, $D\,e$, and $E\,f$ respectively, equal to 18, 14, 27·4954, 29·39387, and 30, and the Distance between

tween the firſt and laſt 24, what is the Area A $v$ B $f$? [See the laſt Figure.]

Here 18+30=48=A, 24+29·39837=53·39387=B, 27·4954=C, and D=6. Hence $\overline{A+4B+2C}\times\frac{1}{3}D=316·56628\times 2=633·13256$ the Area. Otherwiſe you may uſe the Rule belonging to 5 equidiſtant Ordinates, and the Area will be 633·21297, which is near the Truth. Or elſe add the two firſt and two laſt, alſo 4 Times the Third (thus 18+14+30+29·39387, and 27·4954×4) into one Sum, and diminiſh the Baſe in Proportion to the Number of Ordinates added together in each Sum, and then uſe the Rule for two equidiſtant Ordinates, which will give the the Area=634·12631 a little too much.

2. What is the Area of a Quadrant of the Circle which hath its Radius ·5, ſuppoſing the Radius be divided into 5 equal Parts by ſix Ordinates, one of which, or the firſt, will be equal o, another, or the laſt equal Radius, and the reſt, (by the Property of the Circle) will be reſpectively equal to ·3, ·4, ·4582575, and ·4898979? The Anſwer (by finding the Area of the 5 greateſt Perpendiculars, according to Article 291, and adding thereto the Area of the Semi-Segment, which hath its Baſe ·3, and Altitude ·1, conſidering it as a Parabola) will be ·19587022 nearly: And if inſtead of the Area of the Semi-Segment, conſidered as a Parabola, you add its true Area ·020825, there will be found the Anſwer ſtill nearer.

3. Suppoſe there are given three perpendicular equidiſtant Ordinates, of the Part A $v$ C $p$, in the laſt Figure, equal to 2·06, 4·03, 4·5 reſpectively, and their common Diſtance equal to 3, what the Area? *Anſw.* 22·68.

4. Let there be, in the laſt Figure, the Part A $v$ D $e$, and ſuppoſe the Ordinates A $v$, B $n$, C $p$, and D $e$ reſpectively equal, o, 3·88, 5·49, and 6, and that their common Diſtance is 4·163? *Anſw.* 54·93772.

5. Suppoſe, in the laſt Figure, that A $v$=o, B $n$=35, C $p$=40, and the Length A C=30, what is the Area of the Part A $v$ C $p$? *Anſw.* (by the Rule for 3 Ordinates) 900: But by uſing the Rule by 2 equidiſtant Ordinates for the Part B $n$ C $p$, and conſidering the Part A $v$ B $n$, as a Semi-Parabola, the Area will be 912·5.

6. Suppoſe there is given (in the laſt Figure) D $e$=169, C $p$,=110·25, B $n$=64, and B D=24, what is the Area of the Part B $n$ $e$ D? *Anſw.* 2696.

MENSURATION

# MENSURATION.

## *Of* SOLIDS.

293. IN measuring Solids, two Things ought to be considered, *viz.* their *Surfaces* or *Area*, and their *Solidity*.

1. The Surface of a Solid may be conceived, if we suppose it to be sewed in a Cloth, *&c.* and the Cloth to be ript open, and spread out flat: Then the Cloth being considered as, and measured like, a Plane, you will have the superficial Content of the Solid.

2. The Solidity of Bodies may be considered as the whole Space (taken as solid Matter) contained within the Bounds of the Body, or Cloth, *&c.* before ript open. This Solid Content of the Body is computed from another Solid of a determinate Form and Magnitude; namely, from a Cube which hath each Side one *Inch*, *Foot*, *Yard*, &c. called the *measuring Unit*; and the Number of such *Cubes*, or *Units*, (and Parts of an Unit) that any Solid is found to contain, is called the *Measure*, *Solidity*, *Capacity*, or *Content* of the Body.

### 294. *To find the* SURFACE *of a* RIGHT PRISM.

Multiply the Girt or Periphery of the Solid by its Length, the Product is evidently the Area of all except the Bases, which Area must be added to the former for the whole Area.

### 295. *To find the* SOLIDITY *of a* PRISM.

If we conceive a Part of the same Height, which is the linear-measuring Unit, to be cut off from the Prism by a Plane parallel to the Base; and suppose the Area of either End of the Part to contain a certain Number of Squares, (each having its Side the linear-measuring Unit) so similarly posited to the other End, that if the Lines of Division made by these Squares at either End, be cut by perpendicular Planes, the Lines of Division at the other End will be cut by these Planes also; I say, if we suppose this done, 'tis plain that the whole Part will be divided into so many equal Cubes (which are the Content thereof by the last Article) as there are Squares in either End: But the Content of this Part, or Area of its End, drawn into the Number of Parts is the Content of the Whole: And this will hold good in Oblique Prisms, as well as in Right Ones: For Oblique Prisms which have their Bases equal, and are of the same Height with Right

Right Ones, are equal to one another, they having each an equal Number of Planes all similar and equal to their Bases: Wherefore the general Rule will be,

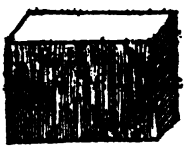
Multiply the Area of the Base by the Length of the Solid for its Content.

EXAMPLES.

1. What is the Surface and Solidity of a Cube which hath each Side 7 Inches? *Answ.* 294 square, and 343 solid Inches.

2. If the Side of the Cube be 62·06 Yards, what is the superficial and solid Content? *Answ.* 21744·24 square, and 218167·208 solid Yards.

3. If each Side of the Base of a Right Square Prism, be twelve Inches, and its Length 15 Feet, what is the superficial and solid Contents? *A.* 111·125 square, and 45·9 solid Feet.



4. If each Side of the Base of a right square Prism be 22 Yards, and the Length 4·2 Yards, what is the superficial Content? *Answ.*

5. There is a rectangular Floor of Malt, which is found in Length 108 Inches, in Breadth 48 Inches, and in Depth at 5 Places, as follows:

$$\left\{\begin{matrix}1\\2\\3\\4\\5\end{matrix}\right\}\text{Place is}\left\{\begin{matrix}4{\cdot}5\\5{\cdot}5\\4{\cdot}9\\4{\cdot}7\\5{\cdot}4\end{matrix}\right\}\text{Inches deep.}$$

The Sum of these Depths, divided by their Number, is what they call the *mean Depth*, from which, and from the Length and Breadth aforesaid, you are required to find the Content in Malt Bushels? *Answ.* the Content is 12·05 + Bushels.

6. Suppose a Plumber hath a rectangular Cistern bespoken, which is to contain 10 Wine Hogsheads, to be 80 Inches in Length, and 63 Inches in Breadth, I demand how many Inches it must be in Depth to contain the said 10 Hogsheads? *Answ.* it must be $28\frac{7}{8}$ Inches,

7. If

7. If a rectangular Ciſtern be 6 Feet 8 Inches long, 5 Feet 3 Inches broad, and 2 Feet $4\frac{7}{8}$ Inches deep, how many Hogſheads of Wine will it hold? *Anſw.* 10.

8. Suppoſe a rectangular Ciſtern 6 Feet 8 Inches long, 4 Feet 3 Inches wide, and 2 Feet $11\frac{1}{2}$ Inches deep, how many Hogſheads of Beer, Country Meaſure, will it contain? *Anſw.* 10.

9. If a rectangular Ciſtern is ordered to be made, which will contain 10 Hogſheads of Beer, Country Meaſure, and the Length and Breadth be limited to 6 Feet 8 Inches, and 4 Feet 3 Inches reſpectively, I demand what the Depth muſt be to anſwer the aforeſaid Order? *Anſw.* $34\frac{1}{4}$ Inches.

10. If a rectangular Ciſtern be ordered for, which is to wet 100 Buſhels of Barley, to be 80 Inches ſquare, (that is 80 Inches long, and 80 wide) what muſt its Depth be, if to the Depth which will contain the Barley there is to be 12 Inches added? *Anſw.* 45·6 Inches.

11. Suppoſe the Stone Plinth, String, and Facia of a Building to be 208 Feet in Length, alſo at a Medium to be 6 Inches thick, and 2 Feet 3 Inches high, what is the ſolid Content? *Anſw.* 234 Feet.

12. If the Length of a Stone Cornice be 283 Feet, its Width 1 Foot 2 Inches, and its Thickneſs 2 Feet 8 Inches, what is the ſolid Content? *Anſw.* 569 Feet 9 Primes.

13. Suppoſe the ſhed Roofings belonging to a Houſe are coped with Stone (having a Moulding on the Edges) 184 Feet in Length, 1 Foot wide, and 4 Inches thick, what is the ſolid Content? *Anſw.* 61 Feet 4 Primes.

14. Suppoſe that to a Stone Door Caſe the Architraves, Jaumbs, and Head are, together, 21 Feet 6 Inches, 8 Inches wide, and 1 Foot 2 Inches thick, what is their Solidity? *Anſw.* 16 Feet, 8 Primes, 8 Seconds.

15. Suppoſe two Pilaſters to be each 7 Feet 9 Inches long, 4 Inches wide, and 8 Inches thick, what is the Solidity? *Anſw.* 3 Feet, 5 Primes, 4 Seconds.

16. If a Piece of ſquare Timber be 30 Feet in Length, and 18 Inches ſquare, (that is, 18 Inches broad, and 18 Inches deep) how many Feet of Timber doth it contain? *Anſ.* 67 ſolid Feet, 6 Primes.

17. If a Piece of Timber be 21 Feet long, 8 Inches wide, and 10 Inches deep, what is its Content in ſolid Feet, *&c.*? *Anſw.* 11 Feet 8 Primes.

18. If a Piece of Timber be 40 Feet long and 2·5 Feet,

or

or 2 Feet 6 Inches square, what is the solid Content? *Answ.* 250 Feet.

19. If the Side of a Cube be 5 Feet 5 Inches, what will it come to the Painting, at 5*d.* per Yard? *Answ.* 8*l.* 2*d.* $0\frac{1}{99}$.

20. If the Length of a right square Prism be 40 Feet, and each Side of its Base 2·25 Feet, or 2 Feet 3 Inches, what will the Painting of it come to at 6*d.* per Yard? *Answ.* 2*l.* 0*s.* 3*d.* $3\frac{1}{33}$.

21. If a Piece of square Timber be 20 Feet 3 Inches long, 18 Inches broad, and 13 Inches deep, what is the solid Content? *Answ.* 32*F.* 10*P.* 10*S.* 6*T.*

22. Suppose a right triangular Prism be 20 Feet long, and each Side of its Base 10 Feet, what is the Area and Solidity? *Answ.* 686·6 square, and 866 solid Feet.

23. Suppose the Length of a right triangular Prism to be 25 Feet 6 Inches, and each Side of the Base 10 Feet, what is its Area and Solidity? *Answ.* 851·6026 square, and 1104·15 solid Feet.

24. Suppose the Length of a right Hexagonal Prism to be 180, and each Side of its Base 16, what is the superficial and solid Content of this Figure? *Answ.* 18610·21184 Feet is the superficial, and 119719·6056 Feet the solid Content.

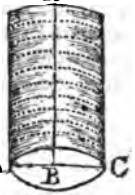
25. Suppose the Length of a right Hexagonal Prism to be 40 Feet, a Side of the Base 10 Feet, and the Perpendicular 86·602 Feet, what is its Area and Solidity? *Answ.* 2918·807 square, and 10392·28 solid Feet.

26. Suppose the Length of a right octagonal Prism to be 180, and each Side of the Base 10, what is the superficial and solid Content? *Answ.* 24005·68 is the superficial, & 86911·2 is the solid Content.

27. If

27. If the Length of a right Octagonal Prism is 50 Feet, and each Side of its Base 5, what is the superficial and solid Content? *Answ.* 2241·42 is the superficial, and 6035 5 Feet is the solid Content.

28. Suppose the right Cylinder A D is 200 Feet in Length, and the Periphery of its Base 10 Feet, what will the Painting such a Body come to at 6*d.* per Yard? *Answ.* 5*l.* 12*s.* nearly.




29. What is the Solidity of the Cylinder which hath its Length 200 Feet, and Periphery of the Base 10? *Answ.* 1591·6 Feet

30. Suppose the Length of a right Cylinder to be 255, and the Periphery of the Base 10, what is the superficial Content? *Answ.* 2565·96.

31. Suppose the Diameter of the Base of a Cylinder 9, and the Length 15, what is the solid Content? *Answ.* 954·261.

### 302. *To find the* Surface *of a* Right Pyramid.

The Product of the slant Height, and Periphery of the Base, divided by two: Or ½ one into the other is evidently the Area of all the Triangles that form it, to which add the Area of the Base for the whole Area.

### 303. *To find the* Solidity *of a* Pyramid.

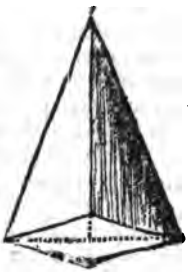
A Pyramid is ⅓ of the Prism that hath the same Base and Height with itself, 7. *e.* 12. therefore the Rule will be,

Multiply the Area of its Base by the perpendicular Height, ⅓ of the Product is the Content: Or one into ⅓ of the other gives it.

### Examples.

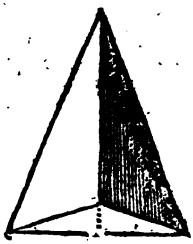
1. Suppose each Side of the Base of the right square Pyramid to be 14, and the slant Length 25, what the Area? *Answ.* 1596.

2. Suppose each Side of the Base of a square Pyramid to be 14, and the Length 25, what is the Solidity? *Answ.* 1568.



3. If each Side of the Base of the right Triangular Pyramid be 10, and the slant Length 20·207, what is the superficial Content? *Answ.* 649·51.

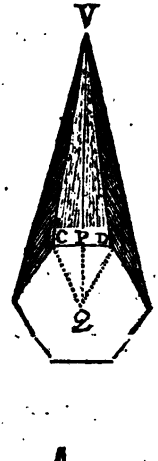
4. If each Side of the Base of a triangular Pyramid be 10, and the Perpendicular Height thereof 20, what is the Solidity? *Ans.* 28·866.



5. If each Side of the Base of a right Hexagonal Pyramid QV be 16, and the slant Length 180·365, what is its superficial Content? *Answ.* 9321·408.

6. If each Side of the Base CD of an Hexagonal Pyramid be 16, & the Perpendicular Height QV 180, what is its Solidity? *A.* 39859·2.

7. If the Axis of a right Hexagonal Pyramid be 180, and each Side of its Base 16, what is its Area? *Answ.* 13286·4.



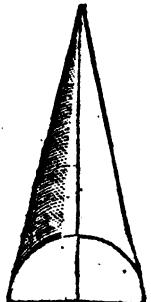

8. Suppose the Periphery of the Base of the right Cone is 45, and the slant Length 200·025328, what is the convex Surface? *Answ.* 4500·57.

9. Suppose the Axis of a Cone 200, and the Periphery of the Base 10, what is the Solid Content? *Answ.* 530·533.

10. If the slant Height of a right Cone be 200·025328, and the Periphery of the Base 10, what is its superficial Content? *Answ.* 1008·08464.

11. If the Axis of a square Pyramid be 15, and a Side of its Base 10·1, what is its Solidity? *Answ.* 510·05.

12. If the Axis of a Triangular Pyramid be 30 Feet, and any Side of its Base 10 Feet, what is the Solidity? *Answ.* 433 solid Feet.



13. If

13. If the Axis of a Cone be 16, and the Diameter of the Base 8, what is the Solidity? *Answ.* 268·0832.

14. If the Axis of a Cone be 68·1, and the Diameter 10, Query the Solidity? *Answ.* 1782·858.

304. *To find the* AREA *of the* FRUSTRUM *of a* RIGHT PYRAMID.

It is manifest that the Sides of the Figure are Trapezoids: Also, that these Trapezoids have one common Height, *viz.* the slant Length of the Frustrum; and that the parallel Sides of these Trapezoids constitute the Ambit of the Ends of the Frustrum: Hence the Rule will be,

Multiply the Sum of the Ambit of the Ends by the slant Length, and take Half the Product: Or one into $\frac{1}{2}$ the other will evidently give the Area of these Trapezoids; to which, if you add the Area of the Ends, you will get its whole Superficies.

305. *To find the* SOLIDITY *of the* FRUSTRUM *of any* PYRAMID.

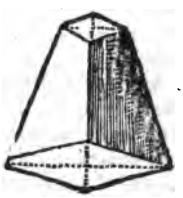
To the Area of the two Ends, add the square Root of their Product; Multiply this by the perpendicular Height, and $\frac{1}{3}$ of the Product is the Solidity of any Pyramid.

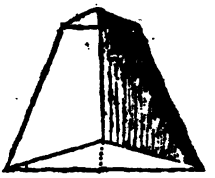
That is, $\frac{\overline{A+a+\sqrt{Aa}}\times h}{3}=\frac{1}{3}\overline{A+a+\sqrt{Aa}}\times h=\overline{A+a+\sqrt{Aa}}\times\frac{1}{3}h$ the Solidity, wherein A represents the Area of the greatest End, $a$ the Area of the least, and $h$ the Height.

EXAMPLES.

1. Suppose a Side of the greatest Base of the Frustrum of a right square Pyramid to be 13, a Side of the least Base 6, and the slant Length 13, what is the Area? *Answ.* 699.

2. Suppose the perpendic. Height of the Frustrum of a square Pyramid to be 13, a Side of the greatest Base 13, and a Side of the least Base 6, what is its Solidity? *Answ.* 1226$\frac{1}{3}$.



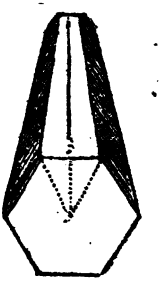


3. If a Side of the greateſt Baſe of the Fruſtrum of a right triangular Pyramid be 10, a Side of its leaſt Baſe 6, and its ſlant Length 20, what is its ſuperficial Content? *Anſw.* 5458·888.

4. If the perpendicular Height of the Fruſtrum of a triangular Pyramid be 30, a Side of its greateſt Baſe 10, and a Side of the leaſt Baſe 6, what is its Solidity? *Anſw.* 848·68.

5. Suppoſe the Ambit of the greateſt Baſe of the Fruſtrum of a right ſquare Pyramid to be 13, of the leaſt 6, and the ſlant Length 13, Query the ſuperficial Content? *Anſwer,* 136·3125.

6. If the perpendicular Height of the Fruſtrum of a ſquare Pyramid be 13, the Ambit of the greateſt Baſe 13, and of the leaſt 6, what is the Solidity? *Anſw.* 70·1649.



7. If the perpendicular Height of the Fruſtrum of a triangular Pyramid be 24, a Side of the greateſt Baſe 13, and of the leaſt 8, Query the ſolid Content? *An.* 1167·368 the ſolid Content.

8. Suppoſe the ſlant Length of the Fruſtrum of a right hexagonal Pyramid to be 30, each Side of its greateſt Baſe 16, & its leaſt Baſe 8, what is the Solidity? *A.* 2990 592.

9. If the perpendicular Height or Length of the Fruſtrum of an hexagonal Pyramid be 24, each Side of its greateſt Baſe 16, its leaſt 8, what is the Solidity? *Anſw.* 9307·008.

10. Suppoſe a Side of the greateſt Baſe of the Fruſtrum of an hexagonal Pyramid to be 13, a Side of the leaſt Baſe 8, and the perpendicular Height 24, Query the Solidity? *Anſ.* 7005·86972.

11. Suppoſe the ſlant Length of the Fruſtrum of a right Cone to be 24, the Diameter of the Ends 13 and 8, what is its ſuperficial Content? *Anſw.* 974 6814.

12. If the perpendicular Height of the Fruſtrum of a Cone be 24, and the Diameters of the Ends 13 and 8, what is its Solidity? *Anſw.* 2117·4228.

13. Suppoſe the perpendicular Height of a Cone to be 18, and the Periphery of the Ends to be 1 8 and 0·92, what is its Solidity? *Anſw.* 2 693313.

306. *To find the curve* SURFACE *of a* GLOBE *or* SPHERE, *or of any Segment or Zone of it:*

Multiply the Circumference of the Sphere by the Height of the Part or Whole required, and the Product is the curve Surface.

That is, $p\,d\,e$ = the Surface; wherein $p = 3{\cdot}1416$, $d$ = the Diameter, and $e$ = the Height = $d$ when a whole Sphere.

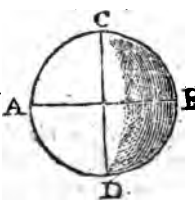
307. *To find the* SOLIDITY *of a* GLOBE *or* SPHERE.

A Sphere may be considered as composed of an infinite Number of Pyramids which have their Vertexes in the Center, and their Bases composing the spheric Surface: Therefore the Rule may be,

Multiply the Surface by $\frac{1}{3}$ of the Radius, or $\frac{1}{6}$ the Diameter, and the Product is the Solidity. Or,

Multiply the Cube of the Diameter by $\left(\frac{3{\cdot}1416}{6}\right)$ ·5236 for the Solidity;

That is, $\overline{p\,d\,d} \times \frac{1}{6}d = \frac{1}{6}p\,d^3$ = the *Solidity*.




EXAMPLES.

1. If the Diameter or Axis of a Globe be 16, what is the convex Surface? *Answ.* 804·2496.

2. If the Axis of a Globe be 16, what is its Solidity? *Answ.* 2144·6656.

3. If the Diameter of a Globe be 10·5, what is the convex Surface? *Answ.* 376·5.

4. If the Diameter of a Sphere be 10·5, what is its Solidity? *Answ.* 658·875.

5. If the Periphery of the great Circle of a Globe be 50, what is its Surface? *Answ.* 795·8.

6. If the Circumference of a Globe be 50, what is its solid Content? *Answ.* 2110·919185.

7. If the Axis, D A, of a Globe be = 10, the Height of a

Segment thereof, E A = 2, what is the convex Surface? *Answ.* 62 832.

8. Suppose the Diameter of a Globe to be 100, what is its Solidity? *Answ.* 523600=1856·734 Ale Gallons.

9. Suppose our Earth to be Spherical, and its Diameter 42017149 Feet, or 7957·8 Miles, what is its Solidity? *Ans.* 371618545156272354787065 6964 solid Feet, or 26386312 2758·4778272 solid Miles.

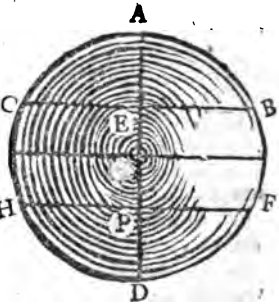
10. If the Diameter of our Earth, supposed Globular, be 7957·8 Miles, what is its Surface? *Answ.* 198945000 square Miles.

11. If the Circumference of our Globe be 25000 Miles, and the Height of each frigid Zone 330·00956811 Miles, what is the curve Surface? *Answ.* 8250239·20275.

12. If the Circumference of our Globe be 25000 Miles, and the Height of the torrid Zone 3173·16558798 Miles, what is the curve Surface of this Zone. *Answ.* 79329139·6995 Miles.

13. If the Circumference of the Earth be 25000 Miles, and the Height of each temperate Zone 2062·3076379 Miles, what the curve Surface? *Answ.* 51557690·9475.

### 302. *To find the* Solidity *of any* Segment *of a* Globe *or* Sphere.




1. *When the Segment's Height and the Axis of the Globe are given.* From 3 Times the Axis or Diameter of the whole Globe, take twice the Segment's Height, multiply the Remainder, the Square of the Segment's Height, and ·5236 continually together for the Solidity required,

That is, $3d-2b \times ·5236\,b^2 =$ the *Solidity*, wherein $d$ represents the Diameter of the Globe, and $b$ the Segment's Height. But

2. *When the Segment's Height, and Diameter of the Base are given,* Take 3 Times the Square of the Radius of the Segment's Base, and add to the Square of its Height, then multiply

tiply this Sum, the said Height, and .5236 continually together for the Solidity,

That is, $\overline{3r^2+b^2} \times .5236\,b =$ the Solidity, wherein $r$ is put for the Radius.

EXAMPLES.

1. If A B C be the Segment of a Globe which hath its Height A E = 2, and the Diameter of its Base C B = 8 Inches, what is the Content in Wine Gallons? *Ans.* .23572+ Wine Gallons.

2. If the Height of the Segment of a Globe be 8, and the Diameter of the Globe 40 Inches, what is the Content in Ale Gallons? *Answ.* 12.3584+

3. If the Segment of a Globe hath its Height 4, the Diameter of its Base 13.856406, or the Globe's Axis 16, what is the Solidity? *Answ.* 335.104.

4. Let the Segment be 4 Feet high, and the Diameter of its Base 24 Feet, what is its Solidity? *Answ.* 536.1664.

5. Suppose the Segment of a Globe is 4 Feet high, the Diameter of its Base 16, and the Globe's Axis 20, what is the Solidity by either of the above Rules? *Answ.* 435.6352.

6. Suppose the Segment of a Sphere be 1, and the Diameter of its Base 2, what is its Solidity? *Answ.* 2.0944.

7. If the Height of the Segment of a Globe be 8 Inches, and the Diameter of the Globe 26 Inches, what is its Content in Wine Gallons? *Answ.* 81.9941+

8. If the Segment's Height be 16, and the Axis of the Globe 80, what is the Solidity? *Answ.* 27880.6528.

9. What is the Solidity of each of the frigid Zones of the Earth, if the Axis or Diameter thereof be, according to Mr. NORWOOD, 7964 Miles, the Diameter of the Zone's Base 3175 6378324 Miles, and its Height 330.2666818 Miles? *Ans.* 1326801006.7374549041208101680636096 solid Miles.

10. Suppose the Diameter or Axis of the Earth be, according to the *French* Mathematicians, $7957\frac{1889}{2180}$ Miles, or to be shorter, let it be 7957 Miles, the Diameter of each frigid Zone 3173.16558798 Miles, and the Height of the Zone 330.00956811 Miles, what is the Solidity of this Zone? *Answ.* 1323704661.175765807302173318186495369 68 solid Miles.

303. *To find the* SOLIDITY *of any* FRUSTRUM *or* ZONE *of a* SPHERE.

To half the Sum of the Squares of the Top and Bottom Diameters add two-thirds of the Square of the Altitude; mul-

tiply this Sum, the Altitude, and ·7854 continually together for the Solidity,

That is, if we put A for the Globe's Axis or Diameter, D for the Diameter of the greatest End of a Frustrum thereof, $d$ for the Diameter of the least End, and $b$ its Height.

$\frac{\overline{D^2+d^2}}{2}+\frac{2}{3}b^2\times\cdot7854b=3\times\overline{D^2+d^2}+4b^2\times\cdot1309b=$ (when it is a middle Zone, or when $D=d$) $\overline{d^2+\frac{2}{3}b^2}\times\cdot7854b=\overline{3d^2+2b^2}\times\cdot2618b=$ (because $A^2=d^2+b^2$) $A^2-\frac{1}{3}b^2\times\cdot7854b=$ the Solidity.

EXAMPLES.

1. If the Diameter C B=H F of either End of the middle Zone C B H K of a Globe be 64, and its Height, P E, 48 Inches, what the Content in Wine Gallons? *A.* 19·1503+

2. If the Diameter of the Frustrum of a Globe at Top and Bottom be 64 and 80 Inches, and its Height 24 Inches, what is its Content in Ale Gallons? *Answ.* 376·4572.

3. The Diameter of either End of the middle Zone of a of a Sphere is 13·856406, and the Height 8, what is its Solidity? *Answ.* 1474·456.

4. Suppose the Top and Bottom Diameters of the Frustrum of a Globe be 8 and 10, and its Height 3, what the Solidity? *Answ.* 207·3456.

5. Suppose the Diameters at the Top and Bottom to be 16 and 20, and the Height of the Zone 6, what is the Solidity? *Answ.* 1658·7648.

6. Suppose the Diameters at Top and Bottom to be 32 and 40, and the Height of the Zone 12, what is the Solidity? *Answ.* 1409·1264.

7. The Diameter of either End of the middle Zone of a Sphere is 16. and the Altitude 12, what is its Solidity? *A.* 3317·5296.

8. Suppose the Diameter of either End of a middle Zone 2, and the Altitude 3, what is its Solidity? *Answ.* 23·562.

9. What is the Solidity of each temperate Zone of our Earth, the Top and Bottom Diameters of each being 3173·16558798 and 7297·78086378 Miles, and Height 2062·307 6379 Miles? *Answ.* 55878802769 41153868 Solid Miles.

10. What is the Solidity of the torrid Zone of the Earth, the Diameter being both at Top and Bottom 7297·78086378 Miles,

Miles, and the Height 3173·16558798 Miles? *Anſw.* 1494 58133943·71170236 ſolid Miles.

Hence the Dimenſions, alſo the ſuperficial and ſolid Meaſure of theſe Zones, and of the whole Globe, will be as follows:

*Of the* TORRID ZONE.

| | *Miles.* |
|---|---|
| The Height or Thickneſs, — | 3173·16558798 |
| Its circular Width, — — | 3263·8 |
| The Axis of the Globe, — — | 7957·8 |
| Each of the Diameters of its Ends, | 7297·78086378 |
| The greateſt Circumference, — | 25000· |
| Area of its Baſes or Ends, — | 83657046 77556169 |
| Sq. Miles in the convex Surface, | 79329139 6995 |
| Its whole Superficies, —— | 162986186·47506169 |
| Its cubic or ſolid Content, — | 149458133943·71170236 |

*Of each* TEMPERATE ZONE.

| | |
|---|---|
| The Height or Thickneſs, — | 2062·3076379 |
| The circular Width, —— | 2986 11 |
| Diameter of its leaſt End, — | 3173·16558798 |
| Diameter of its greateſt End, | 7297·78086378 |
| Area of its greateſt Baſe, — | 41828523·38778084 |
| Area of its leaſt Baſe, —— | 7908176·77320075 |
| Area of its convex Surface, — | 51557690 9475 |
| Its whole Superficies, —— | 101294391·10848159 |
| The cubic or ſolid Content, | 55878802769·41153868 |

*Of each* FRIGID ZONE.

| | |
|---|---|
| Its Height or Thickneſs, — | 330·09568111 |
| The Width of its convex Surface, | 3263 8 |
| The Diameter of its Baſe, — | 3173·16558798 |
| The Area of its Baſe, —— | 7908176·77320075 |
| Its curve Surface, — — | 8250239·20275 |
| It whole Superficies, —— | 16158415·97595075 |
| Its Solidity, —— —— | 13237c4661·17576580 |

*Of the* WHOLE EARTH.

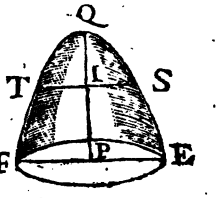
| | |
|---|---|
| Its Diameter or Axis, —— | 7957 8 |
| Its Circumference, — — | 25000· |
| Its Surface, —— —— | 198945000· |
| Its Solidity, —— —— | 263863122758 4778272 |

304. *To find the* SOLIDITY *of a* PARABOLIC CONOID.

Multiply the Area of the Base by the Altitude, Half the Product is the Solidity: Or one into half the other gives it.

That is, $\frac{FE^2 \times .7854 \times QP}{2} = \frac{1}{2}$

$FE^2 \times .7854 \times QP = FE^2 \times .7854 \times \frac{1}{2}QP =$ the *Solidity*.




EXAMPLES.

1. If the Height of a right parabolic Conoid be 24, and the Diameter of its Base 30, what is its Solidity? *Answ.* 16964·64.

2. If the Altitude of a right parabolic Conoid be 20, and the Diameter of its Base 45, what is the Solidity? *Answ.* 15904·35.

3. What is the Solidity of the right parabolic Conoid, which hath its Height 12, and the Diameter of its Base 16? *Answ.* 2412·7488.

4. If the Altitude of a right parabolic Conoid be 30, and the Diameter of its Base 60, what is the Solidity? *Answ.* 42411·6.

5. What is the Solidity of a right parabolic Conoid which hath the Diameter of its Base 30, and its Height 15? *Answ.* 5301·45.

6. Suppose the Height of a right parabolic Conoid to be 20, the Diameter of its Base 40, what is the Solidity? *Answ.* 12566·4.

7. What is the Solidity of a right parabolic Conoid, which hath its Altitude 4 Feet, and the Diameter of its Base 5 Feet? *Answ.* 39·27.

8. Required the Solidity of the right parabolic Conoid, which hath its Height 8, and Diameter of its Base 20? *Ans.* 628·32.

9. If the Height of the right parabolic Conoid be 45, and the Diameter of its Base 50, what is its Content? *Answ.* 88357·5.

305. *To*

305. *To find the* SOLIDITY *of a* PARABOLIC SPINDLE.

Multiply 0·41888, the Axis, and the Square of the greatest Diameter together continually for the Answer.

That is, $\frac{8}{15} \times 3{\cdot}1416 \times Q\,q \times V\,U^2$ = the Solidity.

EXAMPLES.

1. Suppose the parabolic Spindle's Axis or Length 60, the Diameter of its greatest Circle 40, what is its Solidity? *Ans.* 40212·48.

2. Snppose the Length of a parabolic Spindle to be 24, and the Diameter of its greatest Circle 11, what is the Solidity? *Answ.* 1216·422.

3. If the Length of a parabolic Spindle be 24, and the Diameter of its greatest Circle 14, what is its Solidity? *Answ.* 1970·41152.

4. Suppose the Length of a parabolic Spindle be 50, and the Diameter of its greatest Circle 60, what is the Solidity? *Answ.* 75398·4.

5. If the Length of a parabolic Spindle be 36, and the Diameter of its greatest Circle be 40, what is its Solidity? *Answ.* 24127·488.

6. If the Length of a parabolic Spindle be 200, and the Diameter of its greatest Circle be 250, what is its solid Content? *Answ.* 5236000.

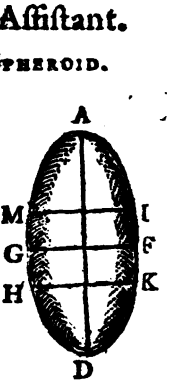
7. What is the Content of a parabolic Spindle which hath its greatest Circle 24, and Length 20? *Answ.* 4825·4976.

8. What is the Content of a parabolic Spindle which hath the Diameter of its greatest Circle 100, and its Axis 450? *Answ.* 1884960.

306. *To*

306. *To find the* SOLIDITY *of any* SPHEROID.

Multiply the fixed Axis, the Square of the revolving Axis, and ·5236 together continually for the Answer.




EXAMPLES.

1. If the fixed Axis of an oblong or right Spheroid be 30, and the revolving Axis 20, what is the Solidity? *Answ.* 6183·2.

2. If the fixed Axis be 20, and the revolving Axis 30, what is its Solidity? *Answ.* 9424·8.

3. Suppose the first Axis of a Spheroid be 15, and the revolving Axis 11, what is its Solidity? *Answ.* 950·334.

4. What is the Solidity of the Spheroid which hath its first Axis 11, and revolving Axis 15? *Answ.* 1295·91.

5. If the first Axis of a Spheroid be 20 Inches, and the revolving one 35 Inches, what is the solid Content in Wine Gallons? *Answ.* 55·58 Wine Gallons.

6. If the first Axis be 35 Inches, and the revolving one 20 Inches, what is the Content in Ale Gallons? *A.* 25·9943 + Ale Gallons.

7. If the first Axis of a Spheroid be 21 Inches, and the revolving one 39 Inches, what is the Solidity? *Answ.* 16724·3076.

8. If the first Axis be 15, and the revolving one 5·25, what is the Solidity? *Answ.* 216·475875.

9. Required the Content of the Spheroid which hath its first Axis 5·25, and its revolving one 15? *Answ.* 6185·025.

307. *To find the Solidity of the* FRUSTRUM *of a* PARABOLIC CONOID.

Multiply the Sum of the Area of the two Ends by the Height or Distance between them, half the Product is the Content: Or one by half the other gives it.

That

That is, $\frac{\overline{FE^2+TS^2} \times .7854 \times PI}{2} = \frac{1}{2}\overline{FE^2+TS^2} \times .7854 \times PI = \frac{1}{2}\overline{FE^2+TS^2} \times .7854 \times \frac{1}{2}PI = \overline{FE^2+TS^2} \times .3927 \times PI$ = the Solidity. [See Fig. Page 154.]

EXAMPLES.

1. If the Diameter of the greateſt End of the Fruſtrum of a parabolic Conoid be 45, the Diameter of the leaſt End 27, and the Height 40 Inches, what the Content? *Anſw.* 55080 ſolid Inches.

2. If the Fruſtrum of a parabolic Conoid be 18 Feet long, and the Diameters of its parallel Baſes 24 and 12, what is its Solidity? *Anſw.* 5089·392.

3. Suppoſe the Height of a parabolic Conoid's Fruſtrum to be 45 Inches, the Diameter of its greateſt Baſe 120, and of its leaſt Baſe 60, what is the Content in Ale Gallons? *Anſ.* 1127·968 Ale Gallons.

4. If the Height of a parabolic Conoid's Fruſtrum be 16 Inches, the Diameter of its greateſt Baſe 55·4, and the Diameter of its leaſt Baſe 32 Inches, what is the Content in Wine Gallons? *Anſw.* 111·333952 Wine Gallons.

5. If a Veſſel in the Form of the Fruſtrum of a parabolic Conoid be 25 Inches high, its greateſt Diameter 90, and its leaſt Diameter 60 Inches, what is its Content in Ale Gallons? *Anſw.* 407·3217.

6. If the greateſt Diameter of a Veſſel in the Form of a parabolic Conoid's Fruſtrum be 60, its leaſt Diameter 45, and their perpendicular Diſtance 18·5 Inches, what is its Content in Wine Gallons? *Anſw.* 241·4595 Wine Gallons.

7. If the Diameter of a parabolic Conoid's Fruſtrum's greateſt Baſe be 40. the Diameter of its leaſt Baſe 16, and their perpendicular Diſtance 42 Inches, how many Wine Gallons will a Veſſel of ſuch Form and Dimenſions contain? *Anſw.* 132·5184 Wine Gallons.

8. If the greateſt Diameter of a Veſſel in the Form of a parabolic Conoid's Fruſtrum be 180, its leaſt Diameter 162, and its Height 19 Inches, what is its Content in Ale Gallons? *Anſw.* 366·2754 Ale Gallons.

308. *To find the* SOLIDITY *of the* FRUSTRUM *of a* PARABOLIC SPINDLE, *one of the Ends of the Fruſtrum paſſing thro' the Center, perpendicular to the Axis of the Spindle:*

To twice the Square of the greateſt Diameter add the Square of the leaſt Diameter, from this Sum take $\frac{4}{10}$ths of the Square of their Difference, multiply the Remainder, the Length, and ·2618 together continually for the Content;

That is, $\overline{2VU^2+MN^2}-{}^{\cdot}4\overline{VU-MN}^2\times cc\cdot 2618=8\overline{VU^2+3MN^2+VU}\times MN\times cc\cdot 05236 =$ the Solidity of the Part $NMUV$; the Double of which will be evidently the Content of a Caſk in the Form of the middle Zone of a parabolic Spindle. [See Fig. Page 155.]

As the greateſt Uſe of this and the following Article is to meaſure Caſks, we ſhall here give a Method whereby the Variety of any common Caſk may be determined, *viz.* Let $\frac{1}{4}$ of the internal Length of the Caſk be ſet off, from the Outſide of the Bulge towards either Head, upon any ſtrait Rod, *&c.* that is placed parallel with the Axis of the Caſk; then, if on the Rod, from the Extremity of the ſaid $\frac{1}{4}$ of the internal Length next the Head of the Caſk, the Perpendicular to the Side of the Caſk be equal to $\frac{1}{8}$ of the Difference between the Bung and Head Diameters, the Caſk is then extremely near (if not exactly) the Form of the middle Fruſtrum of a *Parabolic Spindle:* But if it be leſs than $\frac{1}{8}$ of the Difference of the Bung and Head Diameters, the Caſk will be greater than the middle Fruſtrum of a *Parabolic Spindle*, and therefore may be taken as a *Spheroidical Caſk:* And if this Perpendicular is greater than $\frac{1}{8}$ of the Difference of the ſaid Diameters, the Caſk being then leſs than a *Parabolic Spindle*, may be conſidered as the middle Fruſtrum of an *Hyperbolic Spindle*; ſuch a One as this laſt is beſt meaſured by the General Rule Article 231. [See Mr. Moss's GUAGING, Page 157, for further Information.]

EXAMPLES.

1. If the middle Zone $MMNN$ of a Parabolic Spindle be 10 Feet long; the greateſt Diameter $VU$ 32 Feet, and the leaſt $MN$ 24 Feet, what is its Solidity? *Anſw.* 5590·2368 ſolid Feet.

2. Required the Content of a Caſk in Ale Gallons, in the Form of the middle Zone of a parabolic Spindle, the Bung Diameter

Diameter being 32 Inches, the Head Diameter 24, and the Length 42 Inches? *Answ.* 101·32 Ale Gallons.

3. What is the Content of a Cask in Ale Gallons, of the parabolic spindular Kind, the Bung Diameter being 32 Inches, the Head Diameter 24, and its Length 40 Inches? *Answ.* 96·49+ Ale Gallons.

4. What is the Content of a Cask in Ale and Wine Gallons, in the Form of the middle Zone of a parabolic Spindle, the Bung Diameter being 32 Inches, the Head 24, and the Length 56 Inches? *Answ.* 121·52867 Ale, and 148·35968 Wine Gallons.

5. What is the Content of a Cask in Ale Gallons, of the Form of the middle Zone of a parabolic Spindle, the Bung Diameter being 32 Inches, the Head Diameter 24, and the Length 35 Inches? *Answ.* 75·9554 Ale Gallons.

6. What is the Content of a Cask in Ale Gallons, of the Form of the middle Zone of a parabolic Spindle, the Bung Diameter being 32 Inches, the Head Diameter 24, and the Length 49 Inches? *Answ.* 106·33865 Ale Gallons.

7. What is the Content of a Cask in Wine Gallons, of the Form of the middle Zone of a parabolic Spindle, the Bung Diameter being 32 Inches, the Head Diameter 24, and the Length 70 Inches? *Answ.* 185·4496 Wine Gallons.

8. What is the Content of a Cask in Ale Gallons, in the Form of the middle Zone of a parabolic Spindle, the Bung Diameter being 50 Inches, the Head Diameter 40, and the Length 64 8 Inches? *Answ.* 1058·786+ Ale Gallons.

309. *To find the* SOLIDITY *of a* FRUSTRUM *of an* OBLONG SPHEROID, *one of the Ends thereof passing through the Center perpendicular to the fixt Axis, having given the Length, and the Dimensions of the Ends of the Frustrum,*

Take twice the Area of the greatest End, and add to the Area of the least; multiply the Sum by the Height of the Frustrum, and $\frac{1}{3}$ of the Product is the Solidity;

That is, $\overline{2D^2+d^2} \times b \cdot 2618 =$ the Solidity; wherein D represents the Diameter of its greatest End, $d$ that of the least, and $b$ its Height.

The Double of this Theorem gives the Content of the middle Zone or spheroidical Cask.

EXAMPLES.

1. If the middle Zone M H K I of the Spheroid A G D F be 12 Feet long, the greatest Diameter G F 16, and the least Diameter

Diameter M I or H K 12·8 Feet, what is the Solidity? *Anſ.* 2123·218944.

2. If a Caſk in the Form of the middle Zone of an oblong Spheroid be 16 Inches long, the Bung Diameter 16 Inches, and the Head Diameter 9·6 Inches, what the Content thereof in Wine Gallons? *Anſw.* 10·955477 Wine Gallons.

3. What is the Content of a Caſk in Ale Gallons, of a ſpheroidical Form, which hath its Bung Diameter 64 Inches, its Head Diameter 51·2 Inches, and its Length 96 Inches? *Anſw.* 963·73+ Ale Gallons.

4. What is the Content of a Caſk in Ale and Wine Gallons, of a ſpheroidical Form, which hath its Bung Diameter 32, its Head Diameter 24, and its Length 42 Inches? *Anſ.* 102 31 Ale, and 124·9 Wine Gallons.

5. What is the Content of a Caſk in Wine Gallons, of a ſpheroidical Form, which hath its Bung Diameter 60, its Head Diameter 36·05, and its Length 80 Inches? *Anſw.* 770·6306266 Wine Gallons.

6. What is the Content of a Caſk in Ale Gallons, it being of a ſpheroidical Form, and having its Bung Diameter 80, its Head Diameter 64, and its Length 160 Inches? *Anſw.* 2509·715 Ale Gallons.

7. What is the Content of a Caſk in Ale and Wine Gallons, which is of the ſpheroidical Form, the Length being 110, the Bung Diameter 65, and the Head Diameter 39 Inches? *Anſw.* 1243·22 Wine Gallons.

8. What is the Content of a Caſk in Ale Gallons, of the ſpheroidical Kind, the Length being 42, the Bung Diameter 31·5, and the Head Diameter 24·5 Inches? *Anſw.* 100·78 Ale Gallons.

310. *To find the* SOLIDITY *of a* FRUSTRUM *or* SEGMENT *of a* SPHEROID, *cut by a Plane perpendicular to one of its Axes, having given the Fruſtrum or Segment's Height, and the Axes of the Spheroid.*

1. *When the Fruſtrum or Segment is* perpendicular *to the fixt Axis:*

With the fixt Axis of the Spheroid, and Height of Fruſtrum, or Segment, find the Solidity of the Segment or Fruſtrum of the Sphere of ſuch Dimenſions, and then it will be: As the Square of the ſaid Axis: the Fruſtrum or Segment thus found:: the Square of the Spheroid's revolving Axis to the Solidity required.

2. *When*

2. *When the Frustrum or Segment is* parallel *to the first Axis:*

With the revolving Axis of the Spheroid, and Height of the Frustrum or Segment, find the Solidity of the Frustrum, or Segment of the Sphere of such Dimensions, and it will be As the said Axis: the Frustrum or Segment thus found:: the fixt Axis: the required Solidity.

That is, As $f^2 : \overline{f^2 - 1\frac{1}{3}b^2} \times .7854 b :: r^2 : \frac{f^2 - 1\frac{1}{3}b^2}{f^2} \times .7854\, b\, r^2$ = the Solidity of the Frustrum which is *perpendicular* to the first Axis.

And $f^2 : \overline{3f - 2b} \times .5236\, b^2 :: r^2 : \frac{3f - 2b}{f^2} \times r^2 b^2 .5236$ = the Solidity of the Segment which is *perpendicular* to the first Axis.

Also, $r : \overline{r^2 - 1\frac{1}{3}b^2} \times .7854\, b :: f : \frac{r^2 - 1\frac{1}{3}b^2}{r} \times .7854\, b\, f$ = the Solidity of the Frustrum, which is *parallel* to the first Axis.

And $r : \overline{3r - 2b} \times .5236\, b^2 :: f : \frac{3r - 2b}{r} \times f b^2 .5236$ = the Solidity of the Segment, which is *parallel* to the first Axis.

In each of the above Proportions the second Term represents the Solidity of the corresponding Frustrum or Segment of a Globe, $r$ the revolving, and $f$ the first Axis, and $b$ the Height of the Segment.

EXAMPLES.

1. If the Axes of a prolate or oblong Spheroid be 30 and 20, what is the Content of a Frustrum thereof, which hath its Ends *perpendicular* to the fixt Axis, and one of them passing through the Center, the Height of the Frustrum being 10? *Answ.* 2676·18.

2. If from an oblong Spheroid, which hath its Axes 30 and 20, be cut off a Segment, having its Base *perpendicular* to the fixt Axis, and its Height 5, what is its Solidity? *Answ.* 465·42.

3. If from an oblong Spheroid, which hath its Axes 30 and 20, there is cut off a Frustrum which hath its Height 6, its

its Ends *parallel* to the fixt Axis, and one of them paſſing thro' the Center, what will its Solidity be? *Anſw.* 2159 85.

4. If from an oblong Spheroid; which hath its Axes 30 and 20, be cut off a Segment, having its Baſe *parallel* to the fixt Axis, and its Height 4, what is its Solidity? *Anſw.* 981·75.

5. If the Axes of an oblate Spheroid be 30 and 20, what will the Content of a Fruſtrum thereof be, having its Ends *perpendicular* to the firſt Axis, and one of its Ends paſſing through the Center, its Height being 6? *Anſw.* 3732·2208.

6. If the Axes of an oblate Spheroid be 30 add 20, what will the Content of a Segment thereof be, having its Baſe *perpendicular* to the fixt Axis, its Height being 4? *Anſw.* 980·1792.

7. What is the Content of a Fruſtrum of the ſame Spheroid, which hath its Height 10, its Ends being *parallel* to the fixt Axis? *Anſw.* 4288·8312.

8. If from an oblate Spheroid, which hath its Axes 30 and 20, be cut off a Segment, having its Baſe *parallel* to the fixt Axis, and its Height 4, what is its Solidity? *Anſw.* 423·0688.

311. As we have given Rules for meaſuring Parabolic and Elliptic, and Solids generated by the Revolution of theſe Sections, it may not be amiſs to give the two following Properties by which theſe Figures may be known.

1. In any parabolic Curve it will be, As any Abſciſſa: is to the Square of its Semiordinate :: ſo is any other Abſciſſa: to the Square of its Semiordinate.

2. In any Elliptic Curve it will be, As the Rectangle of any two Abſciſſa's: is to the Square of Half the Ordinate which divide them :: ſo is the Rectangle of any other two Abſciſſa's: to the Square of Half that Ordinate which divides them.

☞ We might proceed to give Rules for other Solids, Fruſtrums, Segments, *&c.* but we muſt obſerve here what we did in Article 295, *viz.* That their Forms muſt be known before the proper Rule can be applied: We ſhall therefore content ourſelves with introducing

312. *A* General Rule *to Meaſure* SOLIDS, *viz.*

To four Times the Area taken in the Middle of the Solid parallel to its two Baſes, add the Area of each Baſe; this Sum

Sum multiply by the Solid's Length, and $\frac{1}{6}$th of the Product is the Area.

That is, $\frac{A+4B \times L}{6} = \overline{A+4B} \times \frac{1}{6} L = \frac{1}{6} \overline{A+4B} \times L =$

the Solidity, wherein A, B, and L denote as mentioned in Article 292.

This Rule is thought to be the *most useful* for Cask Guaging, Guaging of Tuns, *&c.* that can possibly be devised, and holds good not only in Frustrums, *&c.* but also in the compleat Solids, and that whether they be right or oblique: Moreover, it is not only true of Solids generated by the Revolution of Conic Sections, but likewise of all Pyramids and Cones: In short, it is true in all Solids which have their parallel Sections similar Figures, and therefore may serve in Practice to measure all Solids which we *have*, and those which we *shall not*, treat of. The only Difficulty attending this Rule is the finding of the middle Area, which in Practice may be as easily attained as an Area at the End: For in curve-lined Solids it cannot be harder to come at than the Figure's Form: And in streight-lined Solids, which have their Sides Triangles, Trapezoids, *&c.* a Side or Sides, *&c.* in the Middle (which will determine the Middle Area) may be easily found by taking the Half of the corresponding Sides of the two Bases.

It may not be amiss, however, before we proceed with Examples, to give the following Rules for determining the Diameter in the Middle, between the Bung and Head, of a spheroidical, and of a parabolic spindular Cask: This we shall do to shew the Conformity between this general Rule, and those particular Ones, given for their respective Forms:

Given B = the Bung, and H = the Head Diameter of a spheroidical or parabolic spindular Cask, to find M = the Diameter in the Middle between them:

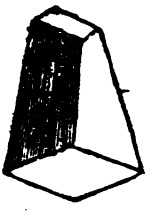
For the spheroidical Cask, $\frac{3B^2+H^2}{4} = M^2$

For the parabolic-spindular Cask, $B - \frac{B-H}{4} = M$

Having

Having given theſe RULES we proceed with

EXAMPLES.



1. How many Ale Gallons will a Solid contain, ſuppoſing its Ends Rectangles, the Length and Breadth of the One to be 27 and 12 Inches, the correſponding Sides of the Other 18 and 8 Inches, and the perpendicular Height 100 Inches? *Anſw.* 80·8488 Ale Gallons.

2. Suppoſe the Fruſtrum of a ſquare Pyramid hath a Side of its greateſt Baſe 13, a Side of its leaſt 6, and its perpendicular Height 6·5, what is the Solidity? *Anſw.* 613½.

3. How many ſolid Feet in a Piece of Timber 15 Feet long, having its Breadth and Depth at the greateſt End 2 and 1·4 Feet, and the Breadth and Depth at the leaſt End 1 and ·7 Feet reſpectively? *Anſw.* 24·5 ſolid Feet.

4. Suppoſe the Height of the Fruſtrum of a parabolic Conoid to be 40, the Diameter of the greateſt End 45, and the Diameter of the leaſt End 27, what is its Solidity? *Anſw.* 55080.

5. If a Bowl, *&c.* be 15 Inches deep, and hath 60 Inches for its greateſt Breadth, 0 for its leaſt, and 40 Inches for the Breadth between the other two, I demand how many Ale Gallons it will hold? *Anſw.* 69·6 Ale Gallons.

6. What is the Content of a Caſk in Ale and Wine Gallons, of a ſpheroidical Form, which hath its Bung Diameter 32, its Head Diameter 24, and its Length 42 Inches? *Anſw.* 102·31 Ale, and 124·9 Wine Gallons.

7. What is the Content of a Caſk in Ale and Wine Gallons, in the Form of the Middle Zone of a parabolic Spindle, the Bung Diameter being 32 Inches, the Head 24, and the Length 56 Inches? *Anſw.* 121·52867 Ale, and 148·35968 Wine Gallons.

8. What is the Content of a Caſk in Wine Gallons, in the Form of the middle Zone of an hyperbolic Spindle, the Bung Diameter being 65, the Head Diameter 39, the Diameter between the Bung and Head 55·9, and the Length 110 Inches? *Anſw.* 1137·29 Wine Gallons.

## *Of the* REGULAR BODIES.

313. That is called a *Regular* Body which hath its Surface compoſed of regular and equal Figures, and which hath its ſolid Angles all equall.—— Of theſe Bodies there are but Five, *viz.*

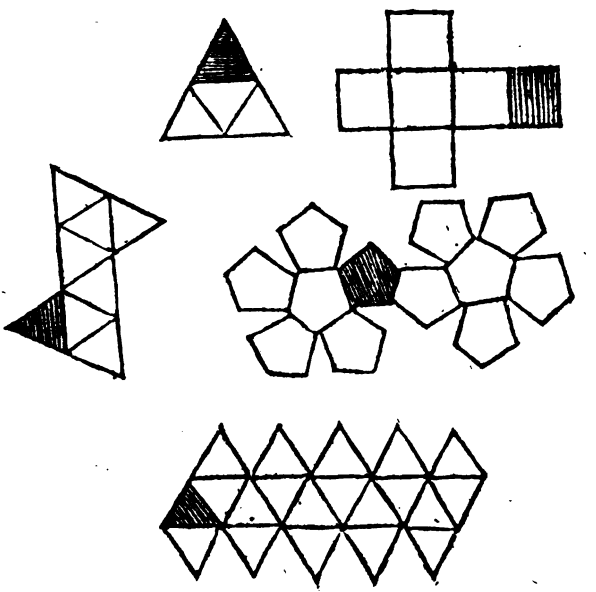
The TETRAHEDRON, which is a Pyramid, and which hath for its Surface 4 equal and equilateral Triangles.

The HEXAHEDRON, or CUBE, which we have already treated of.

The OCTAHEDRON, which hath for its Surface 8 equal and equilateral Triangles.

The DODECAHEDRON, which hath for its Surface 12 equal and equilateral Pentagons. And

The ICOSAHEDRON, which hath for its Surface 20 equal and equilateral Triangles.



The

The Faces of the foregoing Figures being described as before on Card-Paper, *&c.* you may cut the Extreme Sides quite, and the other Sides half through; then if each of their Sides or Faces are folded or brought to meet together, you will have the Form of the Bodies before-mentioned. The Part shaded is the Base around which the rest may be folded, and turned back again, and this Part need not be cut at the Extreme End or Ends.

| | | | | |
|---|---|---|---|---|
| If the Side of the | Tetrahedron | be 1 its Solidity will be | 0·11785113 | Hence, |
| | Octahedron | | 0·47140452079 | |
| | Hexahedron | | 1· | |
| | Icosahedron | | 2·1816949905 | |
| | Dodecahedron | | 7·6631189605 | |

314. *To find the* SOLIDITY of any of the FIVE REGULAR BODIES.

Multiply the Cube of the Side, and the tabular Number belonging to the Body, together for the Solidity.

As these Bodies are all made up of Pyramids which have their Vertexes meeting in the Center of the Body, their Bases being the Sides of the Figure, you may find their Solidity (their Area being easily attained) thus:

Find the Solidity of one of their Pyramids, and multiply by the Number of them for the Content of the Body.

EXAMPLES.

1. If each Side of a Tetrahedron is 20, what is its Solidity? *Answ.* 942·80904.

2. If each Side of an Octahedron be 20, what is its solid Content? *Answ.* 3771·23616632.

3. If each Side of an Icosahedron be 26, what is its Solidity? *Answ.* 17453·559924.

4. What is the Solidity of a Dodecahedron, a Side of which being 20? *Answ.* 61304·951684.

5. What is the Solidity of an Octahedron, its Side being 60? *Answ.* 101823 37649064.

6. If each Side of an Dodecahedron be 30, what is its Solidity? *Answ.* 206904.2119335.

☞ Having, in the Course of MENSURATION, applied it to GUAGING, in order that there shall be nothing wanting on that Subject which may be done with the Pen, we shall in the next Place shew how to find an equated Diameter, or the Diameter of a Cylinder, which, having the same Length with,

with, shall be equal to, a Cask of any Form mentioned in the proceeding Table.

### 315. *To Guage Casks by their mean Diameters.*

Divide the Head Diameter by the Bung Diameter until you have two Places of Decimals in the Quotient; against which, in the Column answering to the proposed Variety, is a Decimal, which being multiplied by the Difference of the Bung and Head Diameters, and the Product added to the Head Diameter, the Sum will be the true mean Diameter sought.

| Quotient of the H. Diam. divided by the B. Diam. | Multipliers for Spheroidical Casks. | Multipliers for the Frustrums of Parabolic Spindles. | Multipliers for the Frustrums of an Hyperbolic Spindle. |
|---|---|---|---|
| ·50 | ·732 | ·693 | ·627 |
| ·51 | ·73 | ·692 | ·626 |
| ·52 | ·729 | ·691 | ·626 |
| ·53 | ·727 | ·691 | ·625 |
| ·54 | ·726 | ·69 | ·624 |
| ·55 | ·724 | ·689 | ·624 |
| ·56 | ·722 | ·689 | ·623 |
| ·57 | ·721 | ·688 | ·623 |
| ·58 | ·72 | ·688 | ·622 |
| ·59 | ·718 | ·687 | ·621 |
| ·60 | ·717 | ·687 | ·621 |
| ·61 | ·715 | ·686 | ·62 |
| ·62 | ·714 | ·686 | ·619 |
| ·63 | ·713 | ·685 | ·618 |
| ·64 | ·711 | ·684 | ·618 |
| ·65 | ·71 | ·684 | ·617 |
| ·66 | ·708 | ·683 | ·617 |
| ·67 | ·707 | ·683 | ·616 |
| ·68 | ·706 | ·682 | ·616 |
| ·69 | ·704 | ·681 | ·615 |
| ·70 | ·703 | ·681 | ·615 |
| ·71 | ·702 | ·681 | ·614 |
| ·72 | ·701 | ·68 | ·613 |
| ·73 | ·699 | ·679 | ·612 |
| ·74 | ·698 | ·679 | ·612 |
| ·75 | ·697 | ·678 | ·612 |
| ·76 | ·695 | ·678 | ·611 |
| ·77 | ·693 | ·677 | ·611 |
| ·78 | ·692 | ·677 | ·61 |
| ·79 | ·691 | ·676 | ·61 |
| ·80 | ·69 | ·676 | ·609 |
| ·81 | ·688 | ·675 | ·609 |
| ·82 | ·687 | ·675 | ·608 |
| ·83 | ·686 | ·674 | ·607 |
| ·84 | ·685 | ·673 | ·607 |
| ·85 | ·684 | ·673 | ·606 |
| ·86 | ·682 | ·672 | ·606 |
| ·87 | ·681 | ·672 | ·605 |
| ·88 | ·68 | ·671 | ·605 |
| ·89 | ·679 | ·671 | ·604 |
| ·90 | ·678 | ·671 | ·604 |
| ·91 | ·677 | ·67 | ·603 |
| ·92 | ·675 | ·67 | ·603 |
| ·93 | ·674 | ·668 | ·603 |
| ·94 | ·673 | ·668 | ·602 |
| ·95 | ·672 | ·668 | ·602 |
| ·96 | ·67 | ·667 | ·602 |
| ·97 | ·669 | ·667 | ·601 |
| ·98 | ·667 | ·666 | ·601 |
| ·99 | ·666 | ·666 | ·6&c. |
| 1·00 | —[&c. | —[&c. | —— |

If

If the exact Quotient of the Head Diameter, divided by the Bung Diameter, cannot be found in the Table, the mean Diameter will differ a little from the Truth; but the greateſt Difference that can happen hereby is wholly inconſiderable in Practice; and this Difference will even become leſs if you obſerve to take out the Multiplier, which anſwers neareſt to the ſaid Quotient.

Any of the Examples in Articles 308, 309, and ſome of theſe in Article 312, may be uſed to exerciſe this Method of Guaging Caſks.

The Reader will find more Tables for his Purpoſe in Mr. Moss's GUAGING, to which Treatiſe we refer him for the Demonſtrations, *&c.*

### 316. *Of the* ULLAGE *of a* CASK.

The Ullage of any Caſk is generally underſtood to be the Part of it which is filled. In this Buſineſs the Caſk is conſidered generally in two Poſitions, *viz.* Standing on one of its Heads, or lying along; that is, with its Axis either perpendicular, or parallel to the Horizon.

### 317. *To find the* ULLAGE *of a* STANDING CASK.

RULE 1. Find the Ullage of the leaſt Part by Art. 312, it will be the Content, if the leaſt Part be filled: But if the greateſt Part be filled, the Content of the unfilled Part, taken from the Content of the whole Caſk, will give the Content of the Part filled, very nearly, let the Caſk be of what Variety it will.

RULE 2. Find the Content contained between the Bung Diameter, and the Diameter of the Liquor's Surface, (as directed in Article 315) agreeable to the Caſk's Variety, which Content added to, or taken from, Half the Content of the Caſk, according as it is more or leſs than half full, will give the required Ullage.

#### EXAMPLES.

1. Let the Diameter of the Liquor's Surface, in any Caſk, be 31·05 Inches, the Head Diameter thereof 26, a Diameter in the Middle, betwixt theſe two, 29·09, and the wet Inches of this, which is the leaſt Part of the Caſk, 10, what is the Ullage in Ale Gallons? *Anſw.* 27·949.

2. If

2. If the Bung Diameter of a Spheroidical Caſk be 35 Inches, the Diameter of the Liquor's Surface 33·5, the Head Diameter 28·7, the Length 40, and the wet Inches 30, what is the Ullage in Wine Gallons? *Anſw.* 114·65 Wine Gallons.

3. If the Bung Diameter of a Caſk in the Form of the middle Zone of a parabolic Spindle be 32 Inches, the Diameter of the Liquor's Surface 30, the Head Diam. 24, the Length of the Caſk 56, and the wet Inches 42, what is the Ullage in Wine Gallons? *Anſw.* 120·9487 Wine Gallons.

4. If the Bung Diameter of a Caſk in the Form of a parabolic Spindle be 32 Inches, the Head Diameter 24, the Diameter of the Liquor's Surface 30, the Length of the Caſk 70, and the wet Inches 17·5, what is the Ullage in Wine Gallons? *Anſw.* 34·434+

5. If the Bung Diameter of a Caſk in the Form of a parabolic Spindle be 31·5 Inches, the Head Diameter 24·5 Inches, the Diameter of the Liquor's Surface 29·75, the Length 42, and the wet Inches 31·5, what Quantity of Liquor is in this Caſk? *Anſw.* 77·9+ Ale Gallons.

6. If the Bung Diameter of a Caſk in the Form of the middle Zone of a Spheroid be 64 Inches, the Head Diameter 51·2, the Square of the Diameter of the Liquor's Surface 3727·36, the Length 96, and the wet Inches 24, what is the Ullage? *Anſw.* 215·569 Ale Gallons.

### 318. *To find the* Ullage *of a* Lying Caſk.

1. *When it is leſs than half full,* Find the mean Diameter by Article 315. From the given wet Inches take half the Difference between the Bung, and this equated Diameter, for the mean or equated wet Inches; then with the equated Diameter and wet Inches thus found, find the Area of the Segment correſponding thereto; this Area, multiplied by the Length of the Caſk, produces the Content of the Liquor in any Caſk when it is leſs than half full.

2. *But if the Ullage be the leaſt, or greateſt Part of the Caſk, and the Content of the greateſt Part is required,* Find the Area of the leaſt Segment, as in the foregoing Rule, and take from the Area of the whole mean Circle, the Remainder being multiplied into the Length of the Caſk will give the greateſt Part ſought.—— Otherwiſe,

In Tables, find the circular Segment, correſponding to the leaſt Part of the Caſk, as before, and take from ·785398, the Remainder will be the Meaſure of a Segment correſponding

to the greateſt Part of the Caſk, which being multiplied by the Sq. of the equated Diameter, and that Product, multiplied by the Length of the Caſk; this laſt Product will be the Content required, *nearly*, which is to be divided by the proper Diviſors for Ale and Wine Gallons, *&c.*

EXAMPLES.

1. Suppoſe a Caſk, of the ſpheroidical Kind, lying with its Axis parallel to the Horizon, hath a certain Quantity of Liquor in it: The Bung Diameter of this Caſk is 32 Inches, the Head Diameter 24, the Length 48, and the wet Inches 14, what is the Content of this Ullage in Wine Gallons? *Anſw.* 59·032 Wine Gallons.

2. Suppoſe the Bung Diameter of a Caſk in the Form of a parabolic Spindle to be 32 Inches, the Head Diameter 26, the Length of the Caſk 40, and the wet Inches 12, what is the Content of this Ullage in Ale Gallons? *Anſw.* 33·3+ Gallons the Content, nearly, or it may be found by Article 312 to be 33·5+ Ale Gallons.

3. Suppoſe the Bung Diameter of a Caſk in the Form of a parabolic Spindle to be 31·5 Inches, the Head Diameter 24·5, the Length of the Caſk 42, and the wet Inches 10·5, what is the Content of the Liquor in this Caſk in Ale Gallons? *Anſw.* 27·5, or thereabouts.

4. What Quantity of Liquor, in Ale and Wine Gallons, is drawn out of the Caſk in the firſt Example? *Anſw.* 68·534 Ale, and 83·665 Wine Gallons.

5. What is the Quantity of Liquor, in Ale Gallons, which is drawn out of the Caſk in the ſecond Example. *A.* 67·116 Ale Gallons.

6. If the Bung Diameter of a Caſk of the ſpheroidical Kind be 32 Inches, the Head Diameter 24, the Length 56, and the wet Inches 14, what is the Ullage in Wine Gallons? *Anſw.* 68·8712 Wine Gallons.

7. What Quantity of Liquor is drawn out of the Caſk in the laſt Example? *Anſw.* 97·6557 Gallons.

8. If the Bung Diameter of a Caſk in the Form of the middle Zone of a parabolic Spindle be 32 Inches, the Head Diameter 26, the Length of the Caſk 50, and the wet Inches 12, required the Ullage in Ale Gallons? *Anſw.* the Ullage is 41·84 Ale Gallons.

## *Of* TIMBER MEASURING.

### 1. BOARD or PLANK.

318. BOARD or PLANK is sometimes sold by the running Foot, sometimes by the square Foot, and sometimes by the solid Foot: When it is sold by the square Foot, and the Board is of the same Breadth throughout, the Length multiplied into the Breadth is the Content. But when the Board is broader at one End than the other, *i. e.* when it is a tapering Board, the Breadth in the Middle, or the two parallel Ends added together and divided by two, multiplied into the Length, is the superficial Content.*

If a Board is sold by the solid Foot, its Content is found like as square Timber.

EXAMPLES.

1. If a Board be 10 Feet long, and 16 Inches wide, what is its superficial Content? *Answ.* 13 square Feet 4 Primes.

2. If a Board or Plank be 20 Feet long, and 10 Inches wide, what is its superficial Content? *Answ.* 16 square Feet, 8 Primes.

3. If a tapering Board be 14 Feet long, and 8 and 11 Inches wide at the parallel Ends, what is its Content? *Answ.* 11 Feet 1 Prime.

4. If a tapering Board be 11 Feet 6 Inches long, and 10 Inches wide in the Middle, what is the Content? *Answ.* 9 square Feet 7 Primes.

5. If a Board or Plank be 15·5 Feet long, and 8 Feet broad, what is its Area? *Answ.* 12·4.

6. What is the Area of a Board which is 14·25 Feet long, and ·75 Feet broad? *Answ.* 10·6875.

### 2. SQUARED TIMBER.

319. In squared Timber, which is equal throughout, or tapering, they multiply the mean Depth by the mean Thickness, and then that Product by the Length for their Content.



* The above Directions for tapering Board being demonstrably true, as may be observed by Article 286, 'tis very extraordinary that Mr. FENNING, in his *School-Assistant*, first Edition, should fall into such a Mistake as to call it *false*, and to give a Rule in its Room, which hath not the least Shadow of Truth: And it is still more extraordinary, that his Editors should leave out in the second Edition what he falsely affirmed in the first, without giving any Reason for it.

EXAMPLES.

1. If a Piece of square Timber, which is equal throughout, be 15 Feet long, and 18 Inches square, *(that is,* 18 Inches broad, and 18 Inches deep) how many Feet of Timber doth it contain? *Answ.* 33 solid Feet 9 Primes.

2. If a Piece of Timber, of equal Thickness, *&c.* throughout, be 42 Feet long, 8 Inches wide, and 10 Inches deep, what is the Content? *Answ.* 23 solid Feet, 4 Primes.

3. If a Piece of Timber, of equal Thickness, *&c.* throughout, be 20 Feet long, and 2 Feet 6 Inches squase, what is its Content? *Answ.* 125 solid Feet.

4. If a Piece of squared Timber be 40 Feet 6 Inches long, 18 Inches broad, and 13 Inches deep, what is its solid Content? *Answ.* 65 solid Feet, 9 Primes, 9 Seconds.

5. Suppose each Side of the greatest Base of a tapering square Piece of Timber be 13, a Side of the least Base 6, and the Length 13, what is its Content by the above Rule? *Ans.* $1173\frac{1}{4}$, which is considerably less than the Truth. [See Example 2, Article 299.]

6. Suppose the Length of a square tapering Piece of Timber to be 19 Feet, and the mean Breadth and Depth, or the Breadth and Depth in the Middle to be 1 Foot and 9 Inches respectively, what is the Content by the aforesaid customary Rule? *Answ.* 14 Feet 3 Primes.

## 3. ROUND TIMBER.

320. In measuring round Timber, they girt it in the Middle with a small Cord, and allow for the Bark about Trees, according to the Custom of the Place, or Thickness of the Bark. Contents are commonly given by this

RULE:

Multiply the Length into $\frac{1}{4}$ of the squared Girt after the Allowance for Bark is made.

☞ This Rule doth not strictly agree with Truth in respect to measuring such Bodies: For if the Circumference of a Circle be 1, its $\frac{1}{4}$ will be ·25, which squared, is ·0625 for the Area of the Girth, as given by the aforesaid Rule: But by Article 285 the Area of such a Circle is ·07958: Hence if the Timber is equal Based, the true Content will be to that found this Way, nearly, as 23 to 18; and consequently the Buyer will have above $\frac{1}{5}$th for Chips: And therefore the ingenious Mr. HUTTON, in his Treatise on MENSURATION, directs you to multiply $\frac{1}{5}$th of the Girt squared into twice the Length. But the Advocates for the first Method alledge, that Trees

are

are not equally good in all their Parts; therefore, say they, to have these several Parts charged of the same Value with good Timber, (or as they charge it now) will be a manifest Injustice. Indeed the Subject of our Enquiry should be to know whether they do, or do not, according to the customary Measure of any Timber, pay for the Value of every Part thereof: If they do, the Rule is *right*: If they do not, it must be *false*.

Now in tapering Trees there is more allowed for Chips by the customary Method of giving Contents than in Trunks of Trees which are equal Based: If therefore Contents by the common Method for equal Based Trees be allowed *right*, those for tapering Trees by this Method must be deemed *false*: Suppose then that the customary, or any other Rule, for equal based Stocks of Trees is just, and that we already know what is allowed thereby for Chips; also that we find the true Content of tapering Stocks of Trees, and make a proportionable Allowance; Would not such an Allowance be just?

The Justness of either of the Rules above-mentioned, for equal-based Trunks, I will not, like many, question: As the present Price of Timber runs, the first may be right; so may the other when the Price of Timber is brought lower. But neither of these Rules will give the true Content, consider it as you please, of tapering Trees. Moreover, cut a Piece of tapering Timber in two, and the Parts will measure (using either of these Rules) more than the Whole; and the nearer the Parts are equal to each other in Length, the greater will the Sum of their Contents be. Cut off a Piece from the least End of some tapering Pieces of Timber, of 2, 3, &c. Feet long, and the remaining Part measured will be (by these Rules) more than the Whole.

I would, at some Time, give a just and practical Method, if I could think it would be admitted in Practice; but tho' it may be made appear ever so just, and ever so practical, I am afraid that they never will forget the present Method, any more than Cross Multiplication, which of all Methods of casting up of Work is the most complex, though so generally used, and therefore useful.

We might say something too on tapering squared Timber: But the Reader will excuse us from this, and for this Digression, and we will proceed with

EXAMPLES.

1. If an equal-based Trunk of a Tree be 8 Feet in Girth, and 36 Feet long, what is the Content? *Answ.* by the customary Method, 144 Feet.

2. If an equal-based Trunk of a Tree be 40 Feet 6 Inches long, and 2 Feet in Girth, how many Feet of Timber is contained therein by the customary Method? *Answ.* 10·12 Feet.

*Note*, In Trees, what is less than 2 Feet in Girth is never accounted Timber.

3. If a round Piece of equal based Timber be 7 Feet 2 Inches round, and 60 Feet long, what is its customary and true Content? *Answ.* 192 Feet, 7 Primes, 3 Seconds, is the customary, and 245·23 Feet the true Content.

4. If a round Tree be 36 Feet long, 13 Feet in Girth at the greatest End, and 3 Feet at the least, what is its Content by the customary Method? *Answ.* 144 Feet.

5. What is the Content of a round tapering Piece of Oak, the Girt at the greatest End being 14, at the least End 2, and its Length 36 Feet? *Answ.* by the customary Method 144 Feet is the Content; by Mr. HUTTON's Rule 184·32 Feet is the Content; but by Article 305 the true Content is 252·10944 Feet.

6. Suppose a Pole is 18 Feet long, and the Periphery of the Ends to be 1·8 and ·92 Feet respectively, what is its customary and true Content? *Answ.* the customary is 2·0808, but the true Content is 2·693313 Feet.

7. Suppose that the Piece of Timber in Example 5th be cut in two thro' the Middle, what is the Content of the Parts added together by the before-mentioned Methods? *Answ.* by the Customary 164·25 Feet, and by Mr. HUTTON's 210·24 Feet.

## RECREATION. I.

1. FIND what 2487 Yards, at $4\frac{1}{4}d.$, 2487 Yards, at 2*s.* $8\frac{1}{4}d.$, and 2487 Yards, at 10*s.* 8*d.* come to by one Stating or Operation? *Answ.* 1704*l.* 12*s.* $7\frac{1}{2}d.$

2. A Merchant of *Exeter* buys 30 Bales of Long Ells, in each Bale 50 Pieces, and in each Piece 29 Yards, at $13\frac{1}{2}d.$ per Yard: He pays also as follows: For Pressing, 8*d.* per Piece; for 1500 Tillets, at $11\frac{3}{4}d.$ each; for 1500 Seals, at $1\frac{3}{4}d.$ each; for 60 *lb.* of Stamps, at 27*s.* per *Cwt.* for 1500 Pair of Pasteboards, at $3\frac{1}{4}d.$ per Pair; for Packing Cloths,

14

1*l.* 14*s.* 9*d.* for Porterage, Shipping, passing the Works, &c. 7¼*d.* per Bale; and for the Freight thereof to *Lisbon* 8*s.* 7¼*d.* per Bale: Now suppose the Factorage comes to 1¼ per Cent. on the Whole, and the Factor pays for Charges at *Lisbon* 114*l.* 13*s.* 4*d.* how must he sell the Goods, so as thereby may be gained Double the Costs and Charges? *Answ.* for 8300*l.* 3*s.* 3*d.*+

3. A Trader at *Virginia* bought 600 Tuns of Tobacco, at 1⅛*d.* per Pound, for which he gave two Tuns of Cheese, at 9*d.* per Pound, 300 Saws at 3*s.* 4*d.* per Saw, 500 Axes, at 2*s.* 6*d.* per Ax, and the Ballance in Money: When he arrived in *London*, he paid 5½*d.* per Pound Duty on his Tobacco; I demand what Cash he paid at *Virginia*, and how he must sell the Tobacco per Pound to get 5000*l.* by it? *Answ.* he paid at *Virginia* 6019*l.* 10*s.* and must sell the Tobacco at 7*d.* $2\frac{9}{13}\frac{9}{14}\frac{0}{3}q.$ per Pound to have his Purpose.

4. Admit an Estate on Lease worth 146*l.* per Annum falls into the Lord's Hand the 23d of *July*, but the Lessee having Corn, &c. on the Premises, keeps it till the *Michaelmas* following, when both Parties agree to account the Half-Year from *Lady-Day* to *Michaelmas*, and the Half-Year from *Michaelmas* to *Lady-Day*, in Value as 3 to 1, and the Rent to be paid accordingly. I demand the Rent due? *Answ.* 40*l.* 16*s.*

5. Bought 25 equal Pieces of Holland for 400*l.* and by selling 5 of the same at 15*s.* per Ell English, find to have losed 4*l.* 10*s.* per Cent. But by Sale of the Remainder, with 3 Months Credit, I find to have gained on the Whole 20 per Cent per Annum. I demand the Length of a Piece in Yards, and what the aforesaid Remainder was sold for per Yard? *Answ.* the Length of a Piece was 25⅗ Yards, and the Remainder was sold at 13*s.* 4*d.* 3½*q.* per Yard.

6, A Baker purchases 20 Sacks of Flour, each containing 280*lb.* 8 thereof at 50*s.* and the other 12 at 42*s.* per Sack; and having sold 494*lb.* of the 8 Sacks at 2*d.* per Pound, he mixeth the rest together, and sells it for 1¼*d.* per Pound; I demand his Gain or Loss on the Whole? *Answ.* he loses 3*l.* 17*s.* 0½*d.*

7. A Baker bought 20 Sacks of Flour, each containing 280*lb.* 8 thereof at 35*s.* and the other 12 at 42*s.* per Sack; he sold 494*lb.* of the 8 Sacks directly for ready Money, and gained thereby 14*l.* 5*s.* 8⅘*d.* per Cent. the rest he mixed together, and by the Sale of it, with 3 Months Credit, gained 40 per Cent. per Annum; I demand what the 494*lb.* and

the Mixture were each sold for, per Whole and per Pound? *Answ.* the 494*lb.* was sold for 3*l.* 10*s.* $6\frac{6}{7}$*d.* at $1\frac{1}{2}$*d.* per *lb.* and the Mixture for 39*l.* 14*s.* 5*d.* at 1*d.* $3\frac{11095}{23539}$*q.* per Pound.

## RECREATION II.

1. What will 50*l.* the Interest payable Quarterly, amount to in 5 Years, at 5 per Cent. per Ann. Compound Interest? *Answ.* 63*l.* 16*s.* $4\frac{1}{4}$*d.* +

2. In the City of *Pekin*, in *China*, is a Bell which is said to weigh 120000 Pounds; at *Nankin*, in the same Empire, there is another which they account 50000 Pounds; the first exceeds the great Bell at *Erford*, in *Upper Saxony*, by 94600 Pounds; how much is the *German* Bell lighter than that at *Moscow*, which is greater than that at *Nankin* by 286000 Pounds? *Answ.* the Bell at *Erford* is 310600 Pounds lighter than that at *Moscow*.

3. If when Corn is 4*s.* 8*d.* per Bushel 10 Ounces of Bread cost $1\frac{1}{2}$*d.* what will the Price of 24*lb.* be when Corn is at 5*s.* 6*d.* per Bushel? *Answ.* 5*s.* 7*d* $3\frac{3004}{5005}$*q.*

4. If 11 Men earn 4*l.* 19*s.* in 6 Days, how many Men will 40*l.* pay for 60 Days? *Answ.* $8\frac{528}{594}$.

5. If 20 Men mow 45 Acres in 2 Days, in how many Days will 5 Men mow 114 Acres? *Answ.* $20\frac{60}{225}$ Days.

6. If 3 Men can thresh 50 Bushels of Wheat in 3 Days, when the Days are 12 Hours long, in how many Days will 5 Men thresh 146 Bushels, when the Days are 10 Hours long? *Answ.* in $6\frac{768}{1500}$ Days.

7. If a Garrison of 2000 Men, having Provisions for four Months, at 22 Ounces per Day for each Man, are reinforced with 2000 more, I demand how many Ounces per Day each must have to make the aforesaid Provisions serve the whole 8 Months? *Answ.* each Man must have $5\frac{1}{2}$ Oun. per Day.

8. How many Bricks, of 9 Inches long, $4\frac{1}{4}$ wide, and $2\frac{1}{4}$ Inches thick, (including the Mortar) will build a Wall 50 Feet long, 10 Feet high, and 1 Brick and half thick? *Answ.* 12000.

9. *A* hath Goods which cost him 13*s.* 4*d.* *B* hath Goods which cost him 16*s.* 8*d.* now if *A* puts his Goods at 16*s.* 8*d.* and receives $\frac{1}{4}$ in ready Money of his Barter Prices, how high must *B* put his Goods to be even with *A*? *Answ.* at 1*l.* 2*s.* $8\frac{8}{11}$*d.*

10. *A* hath Goods which cost him 3*s.* 4*d.* per Pound; *B* hath Goods which cost him 6*s.* 8*d.* per Pound; now if *A* puts his Goods at 6*s.* and receives $\frac{1}{2}$ of this advanced Price

in

in ready Money, how high ought *B* to put his Goods to bring the Barter equal? *Anſw.* at 1*l.* per Pound.

Suppoſe *A* hath 16 Yards of Cloth, at 3*s.* 4*d.* per Yard; but in Barter with *B* will have 6*s.* 8*d.* and $\frac{1}{3}$ of the whole Barter Value in ready Money; now if *B* hath Cloth to be given in Barter worth 6*s.* 8*d.* per Yard, ready Money, how many Yards of Cloth muſt *B* deliver beſides the Money to bring the Barter on an Equality? *Anſw.* $3\frac{4}{7}$ Yards.

## RECREATION III.

1. *D*, *E*, and *F*, enter into Company, *D* puts in 240*l.* *E* 320*l.* and *F* 400*l.* each for 4 Months; they gain 240*l.* what is each Man's Share thereof? *Anſw.* *D*'s 60*l.* *E*'s 80*l.* and *F*'s 100*l.*

2. *X*, *Y*, and *Z*, make a joint Stock for two Months; *X* puts in 916*l.* *Y* 1048*l.* and *Z* 1192*l.* they gain 824*l.* what is each Man's Share thereof? *Anſw.* *X*'s 239*l.* 3*s.* 2*d.* *Y*'s 273*l.* 12*s.* 11*d.* and *Z*'s 311*l.* 2*s.* 8*d.*

3. *C* and *D* entered into Company, *C* put in 740*l.* for 2 Months, and *D* 158*l.* for a Time which is forgot; but it is remembered that the Gains were divided equally between them; you are required to find *D*'s Time? *Anſw.* *D*'s Time was 10 Months.

4. Three Partners, *B*, *C*, and *D*, put into a joint Stock a certain Sum each; *B*'s gains thereby are 9*l.* 10*s.* in 4 Months, *C*'s 9*l.* 16*s.* in 6 Months, and *D*'s 7*l.* in 7 Months; the Total of the Products of each Stock into its own Time is 3756; what was each Man's Stock? *Anſw.* *B*'s 285*l.* *C*'s 196*l.* and *D*'s 120*l.*

5. Three Partners, *B*, *C*, and *D*, made a joint Stock; *B*'s Stock was 285*l.* and he gained thereby 9*l.* 10*s.* *C*'s Stock was 196*l.* who gained 9*l.* 16*s.* *D*'s Stock was 120*l.* and he gained 7*l.* the Total of the Products of each Stock into its own Time is 3756; I demand each Partner's reſpective Time? *Anſw.* *B*'s Time is 4 Months, *C*'s 6 Months, and *D*'s 7 Months.

6. Three Perſons, *B*, *C*, and *D*, enter into Partnerſhip, *B* puts in 285*l.* *C* 196*l.* and *D* 120*l.* whereby *B* gains 9*l.* 10*s.* *C* 9*l.* 16*s.* and *D* 7*l.* the Total of the Times is 17 Months, what is each Man's Time? *Anſw.* *B*'s Time is 4 Months, *C*'s 6 Months, and *D*'s 7 Months.

7. Three Partners, *B*, *C*, and *D*, put into a joint Stock a certain Sum of Money each; *B*'s was in 4 Months, *C*'s 6 Months, and *D*'s 7 Months; *B* gained thereby 9*l.* 10*s.* *C*

9*l.* 16*s.* and *D* 7*l.* their total Stock was 601*l.* what was each Man's Stock? *Anſw. B*'s Stock was 285*l.* *C*'s 196*l.* and *D*'s 120*l.*

8. Three Partners, *B*, *C*, and *D*, made a joint Stock, *B*'s particular Stock was 285*l.* *C*'s 196*l.* and *D*'s 120*l.* and *B* gained thereby 9*l.* 10*s.* in 4 Months; I demand how long *C* and *D* kept into the joint Stock, their particular Sums, their Gains being reſpectively 9*l.* 16*s.* and 7*l.*? *Anſw. C*'s was kept in 6, and *D*'s 7 Months.

9. *B*, *C*, and *D* enter into Partnerſhip, *B* puts in 285*l.* for 4 Months, and gains thereby 9*l.* 10*s.* *C* puts in a certain Sum for 6 Months, and gains 9*l.* 16*s.* and *D* puts in another Sum for 7 Months, and gains 7*l.* I demand what *C* and *D* ſeverally put in? *Anſw. C* put in 196*l.* and *D* 120*l.*

10. *D*, *E*, and *F* enter into Partnerſhip, and make a joint Stock of 370*l.* the particular Stock of each Partner is unknown; *D*'s Money was employed in Trade 3 Months, *E*'s 5 Months, and *F*'s 12 Months; now they gained 100*l.* which according to the Proportion of Stock and Time was equally divided between them; what Money did each Partner put into the common Stock? *Anſw. D* put in 200*l.* *E* 120*l.* and *F* 50*l.*

11. *D*, *E*, and *F* enter into Partnerſhip, *D* puts into the common Stock 200*l.* *E* 120*l.* and *F* 50*l.* the particular Time each Sum was employed is unknown; but their Sum is 17 Months; they gained 100*l.* which was divided equally between them; I demand the reſpective Time each Sum was employed? *Anſw. D*'s was employed 3 Months, *E*'s 5, and *F*'s 12 Months.

12. *D*, *E*, *F*, and *G* enter into Partnerſhip, and make a joint Stock of 2000*l.* the particular Sum of each Partner is unknown; *D*'s Money was employed 12 Months, *E*'s 6, *F*'s 4, and *G*'s 3 Months; they gain 450*l.* which, in Proportion to their Stock and Time, was equally divided amongſt them; I demand what each Partner's Stock was? *Anſw. D*'s 200*l.* *E*'s 400*l.* *F*'s 600*l.* and *G*'s 800*l.*

321. If we put *a*, *b*, *c*, &c. for the particular Stocks of ſeveral Partners in Trade,
*w*, *x*, *y*, &c. their reſpective Times employed,
*e*, *f*, *g*, &c. their reſpective Gain or Loſs,
S the total Stock,
T the Total of the Times, and
G the total Gain or Loſs; we ſhall have the following Proportions for ſolving the Examples in this Recreation.

| | Having given | to find | it will be as |
|---|---|---|---|
| 1 | *a*, *b*, *c*; *w*, *x*, *y*; *and* G | *e*, *f*, *g* | $aw+bx+cy$ : G :: $aw$, $bx$ or $cy$ : *e*, *f*, or *g* |
| 2 | *e*, *f*, *g*; *the Sum of* $\overline{aw+bx+cy}$ = R *and w, x, y or a, b, c inſtead of w, x, y* | *a*, *b*, *c*; *w*, *x*, *y* | G : R :: *e*, *f*, or *g* : $aw$, $bx$, or $cy$; *then* $aw \div w = a$; *or* $aw \div a = w$, &c. |
| 3 | *a*, *b*, *c*; *e*, *f*, *g*; *and* T | *w*, *x*, *y* | $\frac{e}{a}+\frac{f}{b}+\frac{g}{c}$ : T :: $\frac{e}{a}$, $\frac{f}{b}$, or $\frac{g}{c}$ : *w*, *x*, or *y* |
| 4 | *w*, *x*, *y*; *e*, *f*, *g*; *and* S | *a*, *b*, *c* | $\frac{e}{w}+\frac{f}{x}+\frac{g}{y}$ : S :: $\frac{e}{w}$, $\frac{f}{x}$, or $\frac{g}{y}$ : *a*, *b*, or *c* |
| 5 | *a*, *b*, *c*; *e*, *f*, *g*; *and w*<br>*a*, *b*, *c*; *e*, *f*, *g*; *and x*<br>*w*, *x*, *y*; *e*, *f*, *g*; *and a*<br>*w*, *x*, *y*; *e*, *f*, *g*; *and b* | *x*, or *y*<br>*w*, or *y*<br>*b*, or *c*<br>*a*, or *c* | *e* or *a* : $aw$ :: *f* or *b* : $bx$ :: *g* or *c* : *cy* *and* $bx \div b = x$; $bx = b$, &c. |

☞ *When* $e=f=g$; $w=x=y$; *or* $a=b=c$; *theſe Proportions will become more Simple.* &c.

## RECREATION IV.

1. If the Diameter of a Circle be 1, what is the Length of a Side of the Square which ſhall be equal in Area to that Circle? *Anſw.* ·8862.

2. If the Circumference of a Circle be 1, what is the Length of a Side of the Square which ſhall be equal in Area to that Circle? *Anſw.* ·2821.

3. What is the Length of a Side of the Square which may be inſcribed in a Circle which hath its Diameter 1? *Anſw.* ·7071.

4. What is the Length of a Side of the Square inſcribed in a Circle which hath its Circumference 1? *Anſw.* ·2251.

5. What is the Diameter of a Circle which hath its Area 1? *Anſw.* 1·27328.

6. What is the Circumference of a Circle which hath its Area 1? *Anſw.* 12·56637.

7. What is the Square of the Side of the Square inſcribed in the Circle which hath its Area 1? *Anſw.* ·6366.

*Note*, The Solution of this laſt Queſtion, and ſome of thoſe following, depend upon the Reſults of the foregoing Anſwers, and this Proportion, *viz.* The Dimenſions of all ſimilar Plane Figures are in Proportion to their Areas, as the Squares of their reſpective Sides, *& Contra.*

8. If the Side of a Square be 1, what is the Diameter of the Circle which will circumſcribe that Square? *Anſ.* 1·4142.

9. If the Side of a Square be 1, what is the Diameter of the Circle which is equal in Area to that Square? *Anſw.* 1·128.

10. If the Side of a Square be 1, what is the Periphery of that Circle which will circumſcribe it? *Anſw.* 4·443.

11. If the Side of a Square be 1, what will the Periphery of that Circle be which is equal thereto? *Anſw.* 3·545.

12. If a Pipe of 6 Inches bore be 3 Hours in diſcharging a certain Quantity of Water, in what Time will 2 Pipes of 3 Inches bore each diſcharge the ſame Quantity? *Anſw.* in 6 Hours.

*From the laſt Queſtion*, &c. *is proved, that all which Mr.* FENNING *advances concerning Pipes, in Page* 159, *of his* School-Aſſiſtant, *is abſurd.*

13. If a round Ciſtern hath its Diameter 36 Inches, what muſt the Diameter of that Ciſtern be (of equal Height) that will contain twice ſo much? *Anſw.* 50·91+Inches.

14. Given 10·5, 12·5, 14·5, 16·5, and 18·5, five perpendicular equidiſtant Ordinates of an Area, and the common

mon Distance between them 12, to find the Content? *Ans.* the Content is 699.

15. In 432 Statute Acres, how many customary Acres of 6 Poles each? *Answ.* 363.

16. A Floor of Malt, in the Form of a Triangle, is 400 Inches long, 200 Inches broad, and its *mean Depth* is 5 Inches, how many Bushels are contained therein? *Answ.* 93+ Bushels.

17. A Floor of Malt, in the Form of a Trapezoid hath its parallel Sides 75 and 100, the Distance between those Sides 64, and its *mean Depth* 4 Inches, what is the Content in Malt Bushels? *Answ.* 10·41+

18. How much will a Piece of round Timber, in the Form of a Cylinder, which contains 20 solid Feet, lose, when measured by the customary Method? *Answ.* 4·3 Feet nearly.

19. If a Piece of equal-based square Timber be 6 Inches square at each End, how much of this Piece in Length will be equal to $1\frac{1}{4}$ solid Feet? *Answ.* 6 Feet.

20. What is the Difference between a solid half Foot and Half of a Foot solid?

21. If the Length of a Flight of Steps, taken in the Middle over the Riser and Tread, be 12 Times the Breadth of the Step, and the Breadth of the Step taken from $4\frac{1}{6}$ Feet, be $\frac{7}{8}$ of 1 Foot, what is the Content of this Flight of Steps? *Answ.* 168·75 square Feet.

22. If the Ridge of an House with Gable Ends be $2\frac{1}{2}$ Times the Length of the Rafter, and the Length of the Rafter, taken from 12 Feet, be $1\frac{1}{2}$ Feet, what is the Content of that Roof in Slating, allowing three Inches for the lowest Row of Slates? *Answ.* 574 square Feet, 2 Primes, 8 Seconds.

23. A Glazier hath done a Window in the Form of an Half Circle, the Diameter thereof being 6 Feet, exclusive of the Bars; I demand what the Content of this Window is? *Answ.* by Article 273, 18 square Feet.

☞ *Would it not be a good Allowance in curved Windows to suppose the Squares which terminate the Curvature to be compleated, and then to reckon the Area of the Glass, and of these increased Parts for the Content?*

Or, *As Glass is received in round Plates, and therefore no Waste made by cutting it into curved Forms, more than into any other, would it not be much more just and equitable to allow for the Area of the Glass only? As for the Trouble in Workmanship, if there can be more proved in such Windows than in Windows of the common Form, let it be charged like as Tylers charge Hips,*

*Hips, Vallies, &c. but let the* true Content *of Work always be given, for then People know what they pay for.*

## RECREATION V.

1. If 1 Man or 3 Women can do a Piece of Work in 58 Days, how long will 4 Men and 2 Women be doing the ſame? *Anſw.* in 12¾ Days.

2. If *Joan* and *Betty* drink out a Barrel of Beer in 54 Days, and *Polly*, *Dolly*, and *Suſan* in the ſame Time, in how long Time will *Suſan* and *Betty* be drinking it? *A.* in 135 Days.

3. Divide 4*l.* 13*s.* 4*d.* between 4 Men and 8 Boys, give a Man ſo much as 5 Boys, and let me know what each is given? *Anſw.* a Man is given 16*s.* 8*d.* and a Boy 3*s.* 4*d.*

4. A Merchant would exchange 50*l.* 8*s.* 4*d.* for Crowns at 4*s.* 6*d.* Dollars at 4*s.* and Livres at 1*s.* 6*d.* and would have of each an equal Number; what is that Number? *Anſw.* 100 of each Sort.

5. Four Nines may be ſo placed as to make 100, can you place them?

6. Says *Dick* to *Harry*, I can buy 88 Yards of Cloth for 22 Guineas, and 22 triple Crowns; true, ſays *Jack*, ſtanding by, but pray tell me how many Yards I can have for 2 Guineas and 2 triple Crowns, at the ſame Rate, uſing but one Figure for working the Queſtion, and one more in giving the Anſwer?

7. Old *Grannum Betty* is dead, and hath left her Grandſon *honeſt Hodge* 200*l.* and on Condition that he marries, *directly*, his firſt Couſin, *pretty Polly*, who is juſt of Age, he is to receive, for every of their Children produced, 150*l.* more: Now ſuppoſe *Hodge* wins *Poll*, and that ſhe produces two brave Boys per Year for 12 Years, beginning, *honeſtly*, one Year after Marriage; I demand how long theſe Sums, taken as they become due, will be in gaining double their Sum at 5 per Cent. per Annum? *Anſw.* in 26 Years, 249¼⅛ Days.

8. *Bob* and *Betty* drink each ⅛th of a Quart per Draught; their two Daughters, *Polly* and *Dolly* only ⅛d of a Pint each; as oft as *Bob* or *Betty* drink twice, *ſweet Miſs Polly* drinks thrice: Now ſuppoſe *charming Dolly* drinks five Times per Hour, which is twice per Day more than either, I demand how long they all will be in drinking 54 Gall. of Beer? *A.* 4 Days, 6⅘⅔ Hours, the drinking Day being ſuppoſed 12 Hours long.

9. Pro Bono Publico. *Doctor Sangrado*, from *Valladolid*, ſells, per his Bill, his "*famous Purging Pills*," which free

free the Belly from all Impurities at Prime Cost for 6*d.*—— Also, his "*never-failing healing Salve,*" which hath *never* been *attempted* to be prepared by any but by him, for 6*d.*—— Likewise, "*miraculous Plaister Cake,*" which exceeds every Thing, and with which "*all Cures*" may be performed—*curable by it*—for 6*d.* Now suppose the Doctor lowers the Prices, and sells the Whole together at 1*s.* the Pacquet, what will he lose on 475 Pacquets, if he gives, *for your further Encouragement*, with every 100 Pacquets, $\frac{1}{5}$ of the Prime Cost of the 475 in Prizes, and *to his Wife-Man Andrew*, &c. *for collecting together so many Fools*, $\frac{2}{7}$ths of the Remainder? *A.* he loses 32*l.* 1*s.* 9*d.* $3\frac{1}{7}$*q.*

## *Of* BILLS *of* PARCELS, *&c.*

322. A BILL of PARCELS is an Inventory of the Quantity and Price of Goods delivered with them by the Seller to the Buyer, and is made as follows.

NUMBER 1.

Mr. JOHN ADAMS,

*Bought of* WILLIAM WOOLLENDRAPER.

*Exeter, June* 24, 1770.

| | | *s.* | *d.* | |
|---|---|---|---|---|
| 4 | Yards of Fine Broad Cloth, at | 13 | $4\frac{1}{2}$ | per Yard |
| 3 | —— Superfine Ditto, | 18 | 8 | |
| 5 | —— Yard-wide Cloth, | 8 | 6 | |
| 8 | —— Drugget, —— | 6 | 4 | |
| 10 | —— Serge, —— | 2 | 8 | |
| 11 | —— Shalloon, —— | 1 | 9 | |
| | | £. 12 | 9 | 6 |

If the Buyer pay present Money for his Goods, he should have the Receipt written by the Seller at the Foot of the Bill, thus:

*Exeter, June* 24, 1770.

*Received Twelve Pounds Nine Shillings and Sixpence in Full of this Bill, per me*

WILLIAM WOOLLENDRAPER.

Or

Or by his Shopman, thus:

*Received Twelve Pounds Nine Shillings and Sixpence in Full of this Bill, for my Maſter,* William Woollendraper, *per me*

TIMOTHY TRUSTY.

Or perhaps the Receipt may oftentimes run thus:

*Received of Mr.* John Adams, *in Part of this Bill, Seven Pounds, per me*

WILLIAM WOOLLENDRAPER.

The above is the common Method of making out Bills of Parcels, *&c.* The Scholar, in what follows, is ſuppoſed to be in Trade, and to receive Orders, as per Letters from his Country Dealers, *&c.* From each of theſe ſeparate Orders he is required to form his Dealers Bill of Parcels, *&c.*

No. 2.

*Mr.* A. B.

Send, per the firſt Opportunity, 9 Pair of worſted Stockings, at 4*s.* 4*d.* per Pair; 6 Pair of Silk ditto, at 15*s.* 8*d.* 8 Pair of Thread, at 5*s.* 6*d.* 4 Pair of Yarn, at 2*s.* 6*d.* 11 Pair of Womens Silk Gloves, at 4*s.* 4*d.* and 7 Yards of Flannel, at 1*s.* 8¾*d.* per Yard; this, which is all that is at preſent wanted in the Family, place to the Account of

RACHEL RICH.

*To Mr.* A. B.
*in* ———

The Value of this Bill will be 14*l.* 6*s.* 9¾*d.*

No. 3.

*S I R,*

Pleaſe to ſend per Mr. *Marden* the Carrier 24 Yards of Velvet, at 23*s.* per Yard; 22 Yards of Sattin, at 14*s.* 9*d.* per Yard; 24 Yards of Flower'd Damaſk, at 11*s.* per Yard; 18 Yards of Luſtring, at 7*s.* 6*d.* 27 Yards of Venetian Silk, at 15*s.* and 49 Yards of ſprigged Tabby, at 8*s.* per Yard, I am, for my Maſter,

*Your humble Servant,*

*To Mr.* A. B.
*in* ———

SAMUEL SHOPMAN.

The Value of theſe Goods is 99*l.* 12*s.* 6*d.*

No.

No. 4.

*S I R,*

Pleaſe to ſend per the Bearer 22 Yards of Silk Stuffs, at 3*s.* 6*d.* per Yard; 48 Yards of Drugget, at 2*s.* 4*d.* per Yard; 16 Yards of Fuſtian, at 10¾*d.* per Yard; 18 Yards of Frize, at 1*s.* 8*d.* per Yard; 20 Yards of Broad Cloth, at 9*s.* 4*d.* per Yard; and 33 Ells of Kerſeys, at 2*s.* 6*d.* per Ell, for which the incloſed Bill is ſent by

*Your's, &c.*

*To Mr.* A. B. PETER PAYWELL.

*in* ———

The Value of theſe Goods is 25*l.* 2*s.* 6*d.*

No. 5.

*S I R,*

Having been recommended by your Friend D.B. to give you Order, I therefore deſire you will ſend, by the Waggon, 6 Pair of Mens Silk Stockings, at 8*s.* 4*d.* per Pair; 28 Pair of Womens ditto, at 6*s.* 8*d.* per Pair; 24 Pair of Mens Worſted ditto, at 5*s.* 8*d.* per Pair; 35 Pair of Womens ditto, at 4*s.* 2*d.* per Pair; 40 Pair of Womens Thread, at 4*s.* 8*d.* per Pair; and 36 Pair of Womens ditto, at 3*s.* 9*d.* per Pair, for the Amount of which, draw on

*Your's, &c.*

*To Mr.* A. B. HARRY HONEST.

*in* ———

The Value of this Bill is 42*l.* 0*s.* 2*d.*

No. 6.

*S I R,*

Pleaſe to ſend, the firſt Opportunity, 48 Yards of Silk, at 12*s.* 9*d.* per Yard; 45 Yards of Flower'd ditto, at 15*s.* 8*d.* per Yard; 21 Yards of Luſtring, at 6*s.* 8*d.* per Yard; 25 Yards of Brocade, at 11*s.* 4*d.* per Yard; 28 Yards of Sattin, at 10*s.* 6*d.* per Yard; and 44 Yards of Velvet, at 18*s.* 4*d.* per Yard: But as my laſt Parcel was charged at 10 per Cent. more than it ſhould, this I hope will be put at the common Rate it is rendered at by your Neighbours; in which Caſe your Money will be remitted by

*Your's, &c.*

*To Mr.* A. B. THOMAS TRUEMAN.

*in* ———

The Value of this Bill is 142*l.* 2*s.* 10*d.*

*S I R,*

*S I R,*

Pleaſe to ſend per the Bearer 49 Yards of Black Cloth, at 4*s.* per Yard; 47 Yards of Shalloon, at 2*s.* per Yard; 64 Yards of Broad Cloth, at 10*s.* per Yard; 100 Yards of Drugget, at 6*s.* per Yard; 108 Yards of ditto, at 4*s.* per Yard; and 110 Yards of ſuperfine Cloth, at 16*s.* per Yard; for which you may draw on

*Your's, &c.*

*To Mr.* A. B. ABEL ABLE.

*in* ———

The Amount of theſe Goods is 207*l.* 14*s.*

*S I R,*

The following Goods being much wanted, *viz.* 9 Dozen of Silk Stockings, at 14*s.* per Pair; 4 Dozen of Worſted ditto, at 2*s.* per Pair; 4 Dozen of Thread, at 4*s.* per Pair; 4½ Dozen of Womens Silk Gloves, at 6*s.* per Pair; 5½ Doz. of Worſted Gloves, at 2*s.* per Pair; and 72 Yards of Flannel, at 2*s.* per Yard; you are deſired to ſend them by the Bearer to

*Your's, &c.*

*To Mr.* A. B. HENRY HOSIER.

*in* ———

The Value of the Bill is 121*l.*

*Mr.* ———

Pleaſe to ſend, by the next Waggon, 45 Gallons of Brandy, at 5*s.* per Gallon; 67 Gallons of ditto, at 13*s.* per Gal. 47 Gallons of Rum, at 9*s.* per Gallon; 106 Gallons of dit. at 11*s.* per Gallon, and 98 Gallons of Geneva; at 15*s.* per Gallon; for the Amount of which, I have ſent the incloſed Bill, and am,

*Your's, &c.*

*To Mr.* A. B. SIMON SPIRITUOUS.

*in* ———

The Value of this Bill is 207*l.* 15*s.*

*Mr.* ———

Pleaſe to ſend, by the firſt Opportunity, 107 Hogſheads of Cyder, at 21*s.* per Hogſhead; 45 Hogſheads of ditto, at 35*s.* per Hogſhead; 108 Gallons of Rum, at 7*s.* per Gallon; 100 Gallons

Gallons of ditto, at 9*s.* per Gallon; and 64 Gallons of Brandy, at 11*s.* per Gallon; for the Value of which, draw on

*Your's, &c.*

*To Mr.* A. B. PETER PAYWELL.

*in* ———

The Value of this Bill is 209*l.* 2*s.*

*S I R,*

Having compleated my Apprenticeship with your old Dealer Mr. Strange, the first Order on my own Account is for 68 large oiled Lamb Skins at 3s. 4d. per Skin, 154 Goat Skin at 4s. per Skin, 105 small Calve Skins at 6s. 8d. per Skin, 28 larger Calve Skins, at 6s. 8d. per Skin, and 40 red Morocco Skins at 10s. per Skin; these Goods and such as shall be named in future Orders, I desire you will render at the same current Rate as to your other Dealers, and for this Order please to draw on

*Your's, &c.*

*To Mr.* A. B. CHARLES CAREFUL.

*in* ———

The Value of this Bill is 97l. 14s. 4d.

*S I R,*

Please to send per the Carrier 2 Dozen of Candles, at 6*d.* per Pound; 4 Dozen of Soap at 4*d.* per Pound; 94*lb.* of Soap at 8*d.* per Pound; 8*lb.* of Thread at 3*d.* per Ounce; 4*lb.* of Pepper at 2*d.* per Ounce; 2*Cwt.* of Salt at 1½*d.* per Pound; and 480 Yards of Tape at ¼*d.* per Yard, for all which the Bearer of this Letter will pay you.

*I am, &c.*

*To Mr.* A. B. ROGER RETAIL.

*in* ———

The Value of this Bill is 9*l.* 11*s.* 4*d.*

*S I R,*

You are desired to send by the Bearer hereof 156*lb.* of Currants at 10¾*d.* per Pound; 228*lb.* of Malaga Raisins at 5¾*d.* per Pound; 84*lb.* of Raisins of the Sun at 6¾*d.* per Pound; 128*lb.* of Rice at 3¾*d.* per Pound; 16½ Ounces of Cloves at 6¾*d* per Ounce; and 7 Pounds of Pepper at 2¾ per Ounce; for the Value of which make Debtor,

*Your humble Servant,*

*To Mr.* A. B. TIMOTHY TRUSTY.

*in* ———

The Value of this Bill will be 17*l.* 14*s.* 3¾*d.*

*Mr.* A. B.

*Mr.* A. B.

Send the firſt Opportunity 64 Gallons of Palm Sack at 8*s.* 4½*d.* per Gallon; 48 Ditto of Port Wine at 6*s.* 9*d.* 38 Ditto of Liſbon Wine at 4*s.* 10*d.* 56 Ditto of Rheniſh at 6*s.* 6*d.* and 28 Ditto of Sherry at 7*s.* 2*d.* per Gallon; this being what is wanted at preſent, you may place to the Accompt of

SIMON SUCKBOTTLE.

*To Mr.* A. B.
*in* ———

The Value of this Bill is 80*l.* 9*s.* 8*d.*

*S I R,*

The following Goods being much wanted, *viz.* 16*C.* 2*qr.* of Sugar, at 25*s.* per Hundred; 2*C.* 2*qr.* 14*lb.* of Raiſins, at 30*s.* per Hundred; 2*C.* 3*qr.* 14*lb.* at 7*l.* per Hundred; 6*C.* of Prunes, at 22*s.* per Hundred; 4*C.* 2*qr.* of Ginger, at 33*s.* per Hundred; and 18*C.* 2*qr.* of Currants, at 45*s.* per Hundred, you are deſired to deliver them to the Carrier for

*Your's, &c.*

*To Mr.* C. D. HENRY HASTY.
*in* ———

The Value of this Bill is 207*l.* 15*s.*

*S I R,*

Pleaſe to deliver to Mr. *Wilſon*, the Waggoner, 17*C.* 2*qr.* 17*lb.* of Sugar, at 1*l.* 13*s.* 10*d.* per Hundred; 12*C.* 1*qr.* 19*lb.* of Raiſins, at 1*l.* 14*s.* 5*d.* per Hundred; 14*C.* 0*qr.* 12*lb.* of Tobacco, at 4*l.* 19*s.* 4*d.* per Hundred; 1*C.* 0*qr.* 15*lb.* of Rice, at 2*l.* 16*s.* 4*d.* per Hundred; 1*C.* 3*qr.* 19*lb.* of Pepper, at 3*l.* 12*s.* 4*d.* per Hundred; 2*C.* 1*qr.* 19*lb.* of Brimſtone, at 1*l.* 19*s.* 1*d.* per Hundred; and 2*C.* 2*qr.* 12*lb.* of Bees Wax, at 1*l.* 18*s.* 4*d.* per Hundred; for which draw on

*Your humble Servant,*

*To Mr.* D. E. GREGORY GRANT.
*in* ———

The Value of this Bill is 141*l.* 3*s.* 1¼*d.*

☞ Perhaps there may be ſome Objections to the foregoing Bills or Letters; if there be, the Anſwer is, that they ſerve our Purpoſe: We only want to make the Learner underſtand the Method of framing a Bill from a ſuppoſed Letter; at the ſame Time to make theſe Letters ſerve the Plan

of

of our Treatiſe: Number 1, 2, 3, 4, 5, and 6, are intended as an Exerciſe in the ſeveral Caſes of Compound Multiplication; and the reſt are deſigned as an Exerciſe to the ſeveral Caſes of Practice, *&c.* The following Letter is in real Buſineſs, and from which the Scholar may be taught to form many Bills, if he uſe the ſame Sort of Goods with different Prices.

*SIR,*

I deſire you will ſend by the Carrier 4 Pieces of Dowlaſs, from 14*d.* to 22*d.* per Yard; 6 Pieces of Holland, from 2*s.* to 4*s.* 8 Pieces of Cambrick, from 6*s.* to 12*s.* 12 Pieces of blue Hartfords, from 2*s.* to 3*s.* 5 Pieces of Barnſtaple Stuffs, from 18*d.* to 2*s.* 3*d.* and 11 Pieces of Duroys, from 2*s.* to 4*s.* 8*d.* per Yard; for which draw on

*Your humble Servant,*

*To Mr.* D. E. GEORGE GENTINGS.
*in* ——— —

## RECEIPTS.

323. A RECEIPT is an Acquittance or Diſcharge for Money paid, &c.

Received the 14th of October, 1748, the Sum of Fifty-five Pounds, by the Order, and for the Accompt of George Golding, Eſq; per

D. DARY.

Received the 18th of June, 1742, of Mr. Daniel Dinneford and Company, One Hundred Pounds, on Account of Self and Partner, per

T. TURNER.

Received the 29th of February, 1749, of Mr. Aaron Arable in Money Eighteen Pounds, and by an Allowance for Rates, Taxes, and Repairs, Seven Pounds, making together Twenty five Pounds, which is in full for Half a Year's Rent of Town-Place, due at Michaelmas laſt to Lawrence Letland, Eſq; for whoſe uſe it is received, per me

ROBERT RENTRELL.

Received

Received of Mr. F. A. this 24th Day of January 1757, Seven Pounds for a Quarter's Rent, due at Michaelmas laſt, for my Maſter Lancelot Letfarm, per me

F. G.

## *Of* PROMISSORY NOTES.

324. A PROMISSORY NOTE is a written Obligation from one Perſon to another, wherein a Debt is acknowledged, and Payment promiſed at a certain time, as will more plainly appear in the following Examples.

*London, June* 5, 1757.

I promiſe to pay to Mr. J. K. or Order, on Demand, the Sum of Two Hundred Pounds, for Value received,

A. C.

*London, January* 4, 1757.

I promiſe to pay to Mr. G. G. or his Ordea, on the 24th of February next, the Sum of Forty Pounds Fourteen Shillings, for Value received.

A. B.

*London, February* 14, 1757.

Two Months after Date hereof I promiſe to pay to G. G. Eſq; or his Order, Four Hundred Pounds, for Value received.

A. C.

*London, March* 25, 1757.

We, or either of Us, promiſe to pay to Meſſrs. G. and G. or their Order, ten Days after Date hereof, the Sum of Seventy-ſeven Pounds, ſeventeen Shillings, for Value received, Witneſs our Hands,

A. B.
C. D.

## *Of* BILLS *of* EXCHANGE.

325. A BILL of Exchange is a written Order from a Merchant to his Correſpondent for the Payment of a Sum of Money, to the Creditor mentioned therein.

*London,*